EVALUATING THE INFLUENCE OF ENVIRONMENTAL REGULATIONS ON SUSTAINABLE TRADE PRACTICES (IN SELECTED OECD COUNTRIES)

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Abstract: This research investigates the impact of environmental regulations and policies on green trade in selected OECD countries. Environmental regulations play a crucial role in shaping sustainable practices by imposing standards and requirements aimed at mitigating environmental impacts related to international trade. Through analyzing data in selected OECD countries, for a period of 20 years, covering the period 2000-2020, this study aims to explore the extent to which environmental regulation affects the trade in environmental goods, also called 'green trade'. The data were analyzed by using two pooled Ordinary Least Squares models for the selected OECD countries included in the analysis, the first model testing the effects that the environmental policies would have on the environmental goods exports, while the second model testing the effect that environmental policies would have on environmental goods import. Implementing environmental policies and regulations, and raising awareness about the importance of taking action to protect our environment touches different areas, including trade behavior, by moving 'dirty industries' to developing countries, restricting harmful activities, encouraging friendly practices, and increasing the share of 'green exports'. Imposing such requirements creates a new market that demands environmental goods and services that come at a very low cost of the environment, this demand sparks innovation in environmental-related technologies so that companies can remain competitive.
The result of this analysis indicates that a 1 unit increase in the environmental policy stringency, increases environmental-related goods exports by 0.73 percentage points and imports by 0.38 percentage points, meaning that as countries strengthen their environmental policies, it impacts the share of exports and imports of environmental-related goods positively, as they tend to increase. As the demand for these new types of 'green products' increases, the countries are pressured to innovate and shift production towards more environmentally friendly goods and products. Since not all countries have the capability to innovate, there is an increase in the exports and imports of environmental-related goods, due to countries aiming to achieve certain sustainable development goals. The results also indicate that while innovation in environmental-related technologies increases exports by 0.58 percentage points it decreases imports by 0.21 percentage points, meaning that as countries progress and come up with new environmental-related technologies that will be used to produce environmental-related goods, they tend to increase their exports, and since they can produce such goods domestically, they become less dependent on such imports from other countries.
Keywords: exports, imports, environment, policies, green, innovation

1. INTRODUCTION

Global concerns about social and environmental sustainability have led countries worldwide to take measures and initiatives to address these issues. Striving to remain competitive and increase exports might cause companies to engage in unsustainable practices that come at a cost to society and the environment. The recognition that economic activity and trade practices can significantly impact the environment and societal well-being has led countries worldwide to take initiatives and implement environmental regulations, to ensure long-term sustainability.
Environmental regulations include a variety of measures, such as emission standards, environmental provisions in trade agreements, pollution control measures, environmentally related taxes, subsidies, and tax incentives for environmentally related goods/services, all of which aim to lower or mitigate the negative impacts on the environment, which come because of economic activity. All these measures impact the trade behaviors in traditional goods, as well as in environmental-related goods.
Imposing environmental regulations and standards can negatively impact trade practices, as it can have a restrictive effect and reduce the export flows, while on the other hand the commitment of the countries on a global level to address the climate change issues, created new markets for environmental goods, and the share of these goods in total trade is increasing. The dedication to reduce emissions, improve energy efficiency, and reduce waste motivates innovation in new technologies so that these objectives can be met.
Investigating this topic is important to assess if the measures taken by countries effectively promote sustainable trade practices by investigating if the environmental goods imports and exports are affected by more stringent policies, and in which direction. As commitment to sustainable practices has been relatively increasing, the market for environmental-related goods has started to develop, and it includes the trade in goods that either are modified to be more friendly to the environment or are related to mitigating pollution, and efficiently using and managing

natural resources. An increasing demand for these types of particular goods has inspired the countries to innovate and develop new environmental technologies, so that they can produce their goods, remain competitive, and decrease import dependency.

2. LITERATURE REVIEW

As concerns about global warming increase, so do the initiatives and measures aimed at mitigating the negative impacts of climate change that come at the expense of economic activity. Countries worldwide have employed a variety of environmentally related regulations, however, introducing and implementing such regulations, can affect trade patterns, and other aspects of the economy, therefore, numerous researchers have examined the relationship between environmental regulations and trade dynamics.

Since the stringency of the environmental regulation varies among countries, it creates an opportunity for developed countries, which have stricter environmental rules to shift their unsustainable practices in developing countries, where the level of environmental regulation is low. For developed countries, this is an opportunity, since even though they have strong environmental regulations, their implementation comes at a very high cost which might affect their competitiveness, therefore it is easier to shift the burden to the developing countries. This view is supported by Copeland and Taylor (1994), who argues that international trade serves as a tool to move the 'dirty industries' to developing countries that are not subject to strict environmental regulations, and away from developed economies, as developed economies are willing to export labor services in return for imports of pollution services.

One of the ways to commit to sustainable trade practices is by including environmental provisions in regional and preferential trade agreements, meaning by including such provisions, countries put some restrictions on harmful activities or encourage environmentally friendly practices. While the Preferential Trade agreements increase the trade flows between countries, the higher volume of trade tends to increase the ecological footprint of exports from low-income countries, which puts pressure on the environment (Kolcava et. Al, 2019), so by including such provisions, the pressures are intended to be mitigated. However, including such provisions can have a restrictive effect and can lead to a reduced export flow, especially in developing countries (Berger, et.al, 2020). The inclusion of environmental provisions also can be used as a tool to achieve other objectives, for countries that have stricter environmental regulations to reduce the trade pressure from countries with weaker regulations, as those countries can have a competitive advantage. Including the provisions in their agreements can contribute to fairer and sustainable trade practices, which otherwise would gain a competitive advantage over countries with weaker regulations that arise from differences in regulatory standards (Bluemer et al., 2019). On the contrary, countries with weak environmental regulation might not want to include the provisions in their trade agreements, because that would mean that they would lose their competitive advantage in exporting 'dirty goods'. In addition to this, studies have also uncovered that including the environmental provision in preferential trade agreements has a positive effect in promoting environmentally clean industries and reducing foreign direct investment in 'dirty industries' (Lechner, 2018). The World Trade Organization recognized that climate change, the raised awareness about its negative impacts and pressures from consumers who are demanding more environmentally friendly goods will also impact the trade patterns and will create new markets in areas such as environmental goods and services (WTO, 2019), and that by imposing more stringent environmental regulation on domestic producers, will impact their businesses, pressuring them to shift towards production of more environmentally friendly products, therefor resulting in a higher of exports in such products. Authors also found that environmental measures restrict the exports of 'dirty goods', especially in the polluting sectors, while on the other hand increase the share of 'green exports', and environmental goods trade in general (Brandi et. Al, 2020; Cherniwchan et.al, 2017; Cantore and Chang, 2018; Constantini &Crerspi, 2008). Sauvage (2014), found that there is a positive and significant relationship in countries that have stricter environmental regulations with the level of exports of environmental products. This view is also supported by Mealy & Teytelboym (2019) who found out that the countries that have stronger environmental policies tend to be more competitive in exporting green products and at the same time positively impact the environment by reducing carbon emissions (Rufael & Weldemeskel, 2023).

3. RESEARCH METHODOLOGY

This paper's main aim is to evaluate the relationship between environmental regulation and environmental goods exports and environmental goods imports, for the period 2000-2020, in selected OECD countries. The excluded OECD countries in this analysis include Chile, Colombia, Costa Rica, Estonia, Iceland, Israel, Latvia, Lithuania, Luxembourg, Mexico, and New Zealand. The reason for exclusion is the lack of data in one of the indicators analyzed.

Environmental regulation affects trade behavior, and this analysis aims to evaluate how it affects the exports and imports of environmentally related goods. According to the OECD classification of Environmental goods (2003),

this area includes goods related to pollution management, cleaner technologies, and products and resources management.

Since the aim is to assess the environmental regulation's impact on the countries' environmentally related exports and imports, two separate models were conducted, and the following hypotheses were tested:

H0a: Environmental regulations do not impact the exports of environmental goods

H1a: Environmental regulations impact exports of environmental goods

H0b: Environmental regulations do not impact the imports of environmental goods

H1b: Environmental regulations impact imports of environmental goods.

The data were analyzed by using the pooled OLS method, for the period 2000-2020, for the selected OECD countries. The analysis begins by first investigating the impact of environmental regulation on environmental goods exports. The dependent variable in this case is the Environmental Goods exports, expressed as a percentage of the total exports of the country. As an independent variable measuring environmental regulation, was taken the environmental stringency policy index, measures the degree to which countries put a price on harmful processes that hurt the environment. The control variables included are developed of environmental-related technologies per capita, measured as a number of environmental technologies patents filed per capita, and a dummy variable PSDG- Post Sustainable Development Goals, to check if there is a significant difference before and after adopting the SDGs. The value 0 was taken for the years 2000-2014, and the value 1 was taken for the period 2015-2020, to check if the adoption of the goals played an important role in encouraging the trade in environmental products, as the 2030 Agenda and Paris Agreement played a crucial role of countries making effort to combat climate change globally.

The second model differs only in the dependent variable, which was taken Environmental Goods Imports as a percentage of total imports. The independent variables are the same as in the first model.

Both Environmental Goods Exports and Environmental Goods Imports are expressed as a percentage of total exports, and total imports respectively, and are obtained by the IMF database on Climate Change. The Environmental Policy Stringency Index was obtained from the OECD database, and takes the values from 1-6, 1 being the less stringent, and 6 being the most stringent. In the development of environment-related technologies, inventions per capita refers to environmental-related technology patents filed per capita, but in the analysis, the natural logarithm of this variable was taken and obtained from the OECD database.

Table. 3.1. Variables and explanation

variable	Acronym	Measured	Source
Environmental goods exports as percentage of total exports	Egeoftex	Percentage	IMF- Climate change data
Environmental goods imports as percentage of total imports	Egioftim	Percentage	IMF- Climate change data
Environmental Policy Stringency Index	EPSI	Score 1-6	OECD
Development of Environment-related technologies, inventions per capita	DERTIPC	Number of environmental related technologies patents per capita	OECD
Post Sustainable Development Goals	PSDG	0, 1	

Source: Authors source

The following equations were considered:

$$E1:\ EGEOFTEX = \beta_1 + \beta_2 EPSI + \beta_3 LNDERTIPC + \beta_4 PSDG$$

$$E2:\ EGIOFTIM = \beta_1 + \beta_2 EPSI + \beta_3 LNDERTIPC + \beta_4 PSDG$$

The table below represents the descriptive data statistics included in the analysis. The number of observations for Environmental goods exports/imports, Environmental policy stringency index, and post-SDGs is 567, while for the natural logarithm of DERTIPC, there are 540 observations.

The average level of environmental goods exports as a percentage of total exports in the selected OECD countries is 6.8%, the lowest value being 1.46% (Australia, 2013) and the maximum value being 15.43% (Slovak Republic, 2020), with a standard deviation of approximately 3.012. The environmental goods imports have a mean value of 6.6% of total imports, with a standard deviation of approximately 1.95, while the values range from a minimum of 3.23% to a maximum of 14.75%. The Environmental Policy Stringency Index has a mean value of approximately 2.71 and a standard deviation of 0.81, while the values range from 0.53 (Slovenia 2000-2004) to 4.89 (France 2020). While the mean value of the natural logarithm of development of Environmental Related Technologies per capita is 2.3, with a standard deviation of 1.35, the values range from –2.3 to 4.6.

Table 3.2. Descriptive Statistics

variables	obs	mean	Stand dev	Min value	Max value
egeoftex	567	6.844321	3.012438	1.46	15.43
egioftim	567	6.606561	1.958641	3.23	14.75
epsi	567	2.712028	.8138173	.53	4.89
logDERTIPC	540	2.379342	1.352449	-2.302585	4.60547
PSDG	567	.2857143	.4521529	0	1

Source: Authors calculations.

4. RESULTS AND DISCUSSIONS

Considering that the paper aims to test the hypothesis on whether the environmental regulations impact the trade of environmental goods, this section reveals how the variables are correlated and the results obtained from the empirical analysis, generated using the Ordinary Least Squares panel model.

According to the correlation analysis, there exists a moderate positive relationship between the environmental policy and environmental goods exports, the correlation coefficient being 0.3652. The relationship between the dependent variable and the development of environmental-related technologies is also moderate, having a correlation coefficient of 0.3652.

Table 4.1. Correlation Matrix for Environmental Goods Exports

	Epsi	Egeoftex	logDERTIPC
EPSI	1.0000		
egeoftex	0.3652	1.0000	
logDERTIPC	0.5301	0.3825	1.0000

Source: Authors' calculation

The results of the first model, obtained on the impact that the environmental policy has on the environmental goods exports in selected OECD countries are shown below. The dependent variable in the first model is the Environmental goods exports, while the independent variables are the EPSI, PSDG, and log DERTIPC. The data show that there is a significant relationship between Environmental regulation and exports of environmental goods, more specifically, a one-unit increase in the stringency of environmental regulation, the share of the exports in the total exports would increase by 0.73 percentage points. This relationship is highly significant at a 1% significant level, supported by the T-value=4.12. The relationship between the development of environmental-related technologies and environmental exports is also significant at a 1% significance level, so that a 1% increase in the development of such technologies, would increase the share of environmental goods exports in the total share of exports by 0.58 percentage points. However, when comparing the period before and post-adoption of the 2030 Agenda, to check if the adoption of the Sustainable Development goals impacted the exports of environmental goods, the analysis shows that it is not significant, indicating that there is not any difference in the share of environmental exports before and after the adoption of the SDGSs. The model generally is statistically significant, and the independent variables explain about 18.5% of the variations occurring in the exports of environmental goods, as indicated by R2=0.1855.

Table 4.2. Results of the OLS Model, testing the impact of Environmental Regulations, Development of New technologies on Environmental goods exports

Dependent variable ***Egeoftex***	***β***	***Standard dev.***	***t***	***P>|t|***
Epsi	.7397452	.179368	4.12	0.000
LogDERTIPC	.58733	.100881	5.82	0.000
PSDG	.3636647	.2858188	1.27	0.204
Obs	540			
Prob > F	0.0000			
R-squared	0.1855			
Adj R-squared	0.1809			
Root MSE	2.6685			

Source: Authors calculations

The results of the second model, testing the effects that the Environmental Policy Stringency index, the development of environmental-related technologies, and the adoption of the SDGs, on the Environmental goods imports, as a dependent variable are shown below. The model provides important information regarding the relationship between these variables. As we can see from the results, the relationship between EPSI and environmental goods import is highly significant at a 5% significance level, so a 1 unit increase in the index, would increase the share of the environmental goods imports in total imports by 0.38 percentage points. The results also show a highly significant negative relationship between the development of environmental-related technologies and the environmental goods import, so that a 1% increase in the development of such technologies, would result in a decrease in the share of environmental goods import to total imports, by 0.21 percentage points. The coefficient of the dummy variable related to the period Post adoption of the SDG is statistically significant meaning that it has had an impact on the imports of such goods, so that the environmental goods imports are higher by 0.73 percentage points after the adoption. By committing to adopt the SDGs countries that lack technological capacities are dependent and rely on imports for environmentally related technologies and goods to meet these goals, however, the results show that as countries develop their own environmentally related technologies, the imports tend to decrease, and they start to not rely heavily on for certain types of environmental related technologies and goods, since they can produce them domestically. The model is statistically significant; however, the independent variables only explain about 6.5% of the variations in the imports of environmental goods.

Table 4.3. Results of the OLS Model testing the impact of environmental policy and development of environmental technologies on Environmental goods imports

Dependent variable ***Egioftim***	***β***	***Standard dev.***	***t***	***P>|t|***
Epsi	.3825433	.1239164	3.09	0.002
LogDERTIPC	-.2112016	.0696936	-3.03	0.003
PSDG	.7271619	.1974578	3.68	0.000
Obs	540			
Prob > F	0.0000			
R-squared	0.0650			
Adj R-squared	0.0598			
Root MSE	1.8435			

Sources: Authors' calculations

The results of both models show important information on how environmental regulation and the development of new technologies impact the import and export of environmental-related goods. Both models are statistically significant and show that in fact, these variables explain some part of the variations in the exports and imports of these goods. The H0a, that the environmental regulation has no significant impact on the exports of the environmental goods is rejected, since according to the results, there is a significant positive impact on the exports of these goods. The H0b is also rejected since environmental regulations have proved to have a positive impact on the import of environmental-related goods as well.

5. CONCLUSIONS

The introduction and development of environmental regulations and standards in countries is an important tool in striving to achieve sustainable development, however, it affects production, consumption, and trade behaviors. While stricter environmental regulations may pose challenges to businesses by increasing the costs that arise for complying with such regulations, they also stimulate innovation and the development of environmentally friendly products. The results of this analysis provide important information on how the environmental regulation and development of new environmentally related technologies impact trade behaviors in environmentally related goods.

The results show that stricter environmental regulations increase exports of environmental-related goods, so a 1 unit increase in the stringency of environmental policies increases exports by 0.73 pp, proving the H1a hypothesis that environmental regulation has a significant impact on the exports of environmental goods. The results also indicate that imports of environmental-related goods are affected by environmental regulation, so a 1 unit increase in the stringency of environmental policies, increases imports by 0.38 pp, proving the H1b hypothesis that environmental regulation impacts the imports of environmental goods.

Since countries are motivated to innovate to remain competitive, the results of this analysis also indicate that the development of environmental-related technologies increases exports but decreases imports of these types of goods.

The 2030 Agenda and the Paris Agreement can be considered a landmark for sustainable development, since countries on a global level committed to meeting the 17 Sustainable Development Goals and keeping the average temperatures below 2 Degrees Celsius pre-industrial levels, the trading behavior of the goods was analyzed, to see if the adoption of these goals affected the trade patterns, and the analysis shows that after the adoption of the SDGs, the imports are higher for 0.72 percentage points. This indicates that to meet the goals, countries primarily relied on imports; however, as they become more innovative, they tend to be less import-dependent, since they can increase the domestic production of environmentally related goods. Even though countries by implementing environmental regulation, are trying to contribute to the environment and mitigate climate change, progress is minimal, indicating that countries need to further continue and improve their environmental policies to achieve environmental sustainability, while at the same time to meet their economic goals.

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