Erasmus University Rotterdam

Erasmus School of Economics

Bachelor Thesis, International Bachelor in Economics and Business Economics (IBEB)

The relationship between environmental policy and the size of the industry for environmental businesses around the world.

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Date: 28/07/2020

Abstract: Due to the degradation of the environment in consequence of human activity, the environmental goods and services industry has been growing in the search for greener business practices. This paper seeks to find any relationship between the growth of this industry and environmental protection policies coming from the government. To do so, a detailed theoretical framework is constructed which leads to the formulation of relevant hypotheses that help confirm the existence of this relationship. To test said hypotheses, this paper uses panel regressions with country and year fixed-effects. The results show that there is a positive relationship between countries with established environmental protection policies and the size of the environmental goods and services industry. This study strives to enlighten future policymakers into choosing strategies that will help improve the health of the environment and stimulate the economy simultaneously.

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1. Introduction

Entrepreneurial activity has always been a part of human history. The Austrian economist Schumpeter (1982) believed entrepreneurship to be society's way to respond to a stagnating market. He explained that entrepreneurs were those who looked at an existing industry and transformed it through innovation. This is how humans came from living in caves, to creating trade, to having access to the internet daily. Nowadays, this is no different. There are thousands of people worldwide innovating to solve society's problems.

However, entrepreneurs and established businesses have not always followed practices that contribute to the protection of the environment, regardless of how lucrative the outcomes are. Many business activities, particularly in the past century, have had devastating effects on the health of the ecosystems. Thus, in recent years, environmental consciousness has become an increasingly popular topic of discussion in countries' politics, business practices, and individual preferences alike. Researchers have proved that nature is especially vulnerable to human activity due the limited adaptive capacity, and some systems may even undergo irreparable damage (Ambec & Lanoie, 2008). In the past decades, governments have established regulations aimed at the reduction of pollutant processes to increase environmental welfare. These may come as tax breaks, environmental taxes, subsidies, grants, etc. Given this shift in acceptable business methods, academics have argued that it is in an industry's best interest to redesign their processes to be more environmentally friendly (Andrews, 1998).

This shift not only applies to existing firms trying to change their practices to be more eco-friendly but also to entrepreneurs who want to start new ventures in compliance with these new rules. This pressure gives birth to a new type of entrepreneurial activity, called Environmental Entrepreneurship. It is defined as an activity that seeks to promote environmental welfare and addresses various sustainability problems specifically while still being financially sustainable (O'Neil & Ucbasaran, 2016). However, according to Demirel, Rentocchini, and Tamvada (2019), the evidence is inconclusive as to whether these green enterprises are founded for altruistic purposes or if their objectives are primarily rooted in profit maximization. Nowadays it is factual that businesses must not only comply with institutional norms but must also compete through

distinctiveness (De Clercq & Voronov, 2009) and environmental friendliness might be one of these differentiators.

Regardless of the motivators for environmental entrepreneurship, players must still comply with formal institutions' norms. These norms, in the form of policies, might have an effect on the number of green businesses that are created. Policies and laws are of great influence in the entrepreneurial environment of a country, Criscuolo and Menon (2015) say: "National environmental policies might strongly affect the expected commercial viability and future profitability of nascent ventures in the green energy sector". This paper seeks to dive deeper into the existence of a relationship between policy and the size of an industry, thus it proposes to answer the following research question:

Are environmental protection policies related to the size of the environmental goods and services industry?

This research question is of social relevance as it might shine a light on future policymakers on the effect of their work on a selected industry. It might give an idea of how much their efforts are providing the desired results and provide guidance on which policy is the most effective at the time of needing results.

It is of scientific relevance because it adds to the existing literature about the governmental impact on the size of a particular industry, for this paper, the size of the environmental goods and services industry. The answer to this research question adds to the literature because it will agree or disagree with what previous researchers (Criscuolo et al., 2015; Dean & McMullen, 2007; Linde, 1995; Gibbs, 2009; Meek, Pacheco, & York, 2010, and others) have established, which is that government regulation and policy have an effect on the creation of new businesses, more specifically new "green" businesses, and by consequence increasing the size of this industry.

This study answers the question by testing two different hypotheses that give clarity about the relationship between governmental incentives and the size of the environmental goods and services industry around the world. These hypotheses are tested using two different panel

regressions with country and year fixed-effects. Twenty-four countries are analyzed in total throughout 2003-2016. Using environmental tax revenue and the environmental policy stringency index from OECD as independent variables, it is possible to test for the statistical association between government intervention and ecopreneurship. The results show that there is a statistically significant relationship between the environmental tax revenues a country receives and the size of the environmental goods and services industry in that country. The results also show a positive correlation between the level of stringency and the size of this industry.

In addition to this introduction, this paper is divided into five more sections. Section 2 explores the theoretical framework, Section 3 and 4 explain the data and methodology used to test the formulated hypothesis, Section 5 presents the results of the economic models, and finally, Section 6 observes the discussion and conclusions that can be derived from the investigation.

The following section investigates previous literature on the matter of entrepreneurship, the deterioration of the environment, the birth of environmental entrepreneurship, entrepreneurship and formal institutions, and the most commonly used environmental protection policies to form a theoretical framework. The hypotheses to test and answer the research question are derived from the information in this framework.

2. Theoretical Framework

This section presents the theoretical framework for this paper. The framework explores the topics of entrepreneurship, the environment, and formal institutions such as the government and seeks to find the relationship between all three. This framework contains the relevant hypotheses to test in order to answer the aforementioned research question.

2.1 Entrepreneurship and the Environment

Section 2.1 investigates the definitions of entrepreneurship and the degradation of the environment and finds the relationship between the two in the form of environmental entrepreneurship.

2.1.1 Entrepreneurship

There have been many definitions for entrepreneurship throughout history, author Gutterman (2015) writes a lengthy essay where he explains several conceptualizations of it. He begins by establishing that one of the earliest definitions focused on merchants who were willing to assume the risks of purchasing items at certain prices while there was uncertainty about the prices at which those items could eventually be resold. Gutterman continues to explain that this definition evolved into focusing on the risk associated with combining factors of productions to generate outputs that were made available for sale in a changing market. He adds the important remark that Schumpeter (1982) was the first to include innovation in the definition of entrepreneurship and believed strongly that the role of the entrepreneur was to create and respond to economic discontinuities. This paper, as mentioned in the introduction, uses the definition of entrepreneurship from Schumpeter, in the sense that it can be defined as innovation within a market that transforms and evolves said market. The work of an entrepreneur affects the society where they live, as new technology is what ultimately drives the development of communities.

Entrepreneurship is an essential driver of societal health and wealth, and it is an engine of economic growth (GEM, n.d). The Global Entrepreneurship Monitor (GEM) believes that it is through entrepreneurship that markets are obliged to innovate, explore new opportunities, promote productivity, create employment, and address society's current challenges. Furthermore, author Kuratko (2011) writes that entrepreneurial firms are indispensable to market economies. He emphasizes that entrepreneurship is an integral part of the renewal process that defines market economies and that entrepreneurial firms are also an important source of new employment opportunities. Thus, countries around the world benefit from constant innovation and healthy market competition.

However, entrepreneurship is not the same everywhere and every time. Authors Audretsch, Grilo, and Thurik (2007) explain that different countries have different rates of entrepreneurial activity due to several reasons, these may be the political environment, social norms, the health of their economy, etc. and that this variety is difficult to measure due to a lack of set indicators. Following this line of thought, Dollinger (2008) explains there must be two conditions for entrepreneurship to flourish: the freedom to start a venture (formal and informal institutions

allowing for this activity), and favorable economic conditions. Thus, regardless of where the entrepreneur is in the world if these two conditions are met, in theory, they should be able to start their own business and take advantage of market openings.

The combination of those two factors results in something every entrepreneur must be able to identify: an opportunity. There are three approaches to define entrepreneurial opportunity (Cohen & Winn 2007):

1. **The allocative view**: suggests there is an opportunity in the market when there is potential for redistribution of resources without making others worse off, also known as Pareto improvement.
2. **The discovery view**: suggests that opportunities arise from information asymmetries in the market.
3. **The creative view**: explains that entrepreneurs seek to maximize utility functions of stakeholders and that opportunities can only be identified after-the-fact.

After the opportunity is identified, then entrepreneurs must act upon them and take advantage of the market conditions. In the past decades, the environment's degradation has been a focal point for new entrepreneurial activity to try and improve the health of the ecosystems and drive the economy simultaneously. A brief explanation of the environmental degradation and sustainability urgencies are explained in the following section.

2.1.2 The devastating deterioration of the environment

In the past century, the Earth's ecosystem has been affected by human activity. The deterioration of the environment is a consequence of unethical business practices and affects all species living on Earth. This is why individuals, governments, and businesses must look for a solution to improve the state of the environment while still producing profits and stimulating the economy. A consequence of this deterioration is climate change, which authors Cohen and Winn (2007) define as "one aspect of changes to and degradation of the eco-systems whose services sustain all life, including human economic endeavor, on earth".

The consequences of this change in the environment can be lethal for many species. Climate change leads to a rise in temperature which results in the melting of the ice caps, extreme weather events, and the rise of the level of the ocean (Bradford, 2017). These changes also affect the way humans live, for example, the agriculture industry could completely disappear if the weather changes become too extreme for crops to survive. Hence, there is an urgency to change the way humans currently sustain live not only for altruistic reasons but also because it affects economic welfare worldwide.

The global economies are based on goods and services from the ecosystems. Everything humans create and deliver is derived from what the environment provides: water, timber, coal, etc. However, humanity has focused too much and too long on what it can take from these ecosystems and not on the impact of these actions (Wood, Sebastian, & Scherr, 2000). Cohen and Winn (2007) present an analysis that summarizes the challenges faced by Earth's most critical ecosystems, their findings are presented in Table 1, and are derived from information from the "Pilot analysis of global ecosystems: agroecosystems", PAGE, (2000). Table 1 suggests that societal habits are affecting every ecosystem.

Human activity is impacting the whole environment negatively, in consequence, established businesses have faced pressure from stakeholders to change their practices to be more environmentally friendly and to reduce their CO_2 and pollution footprint (Wright & Nyberg, 2017). These authors confirm that many corporations have responded to this pressure through what Jermier, Forbes, Benn, and Orsato (2006) call "new corporate environmentalism" defined as "rhetoric concerning the central role of business in achieving both economic growth and ecological rationality as a guide for management that emphasizes voluntary, proactive control of environmental impacts in ways that exceed or go beyond environmental laws and regulatory compliance". In other words, existing corporations have started "greening" their practices to have a smaller negative impact on the environment. Nevertheless, not only established corporations have this pressure to improve their methods.

Table 1.

Critical Global Ecosystems

Ecosystem	General Description	Challenges
Agricultural	Land surfaces devoted to agricultural purposes which account for $1.3 trillion in output of food, feed, and fiber, 99% of calories consumed by humans.	Since 1950, 40% of agricultural land worldwide has been severely degraded through erosion, salinization, nutrient depletion, biological degradation, and pollution. The diminishing supply of quality water also continues to provide challenges.
Coastal	Land surfaces adjacent to continental and island boundaries which are home to 39% of the world's population and account for 95% of the marine fish caught for consumption.	Overfishing, destructive trawling techniques, and destruction of nursery habitats have diminished by 20% the stock of fish and shellfish. The use of synthetic chemicals and fertilizers in neighboring regions lead to pollution problems for coastal lands. Global warming also impacts coastal ecosystems through warming of ocean temperatures, changing storm frequency, and rising sea levels.
Forest	Land areas accounting for the largest source of wood products and millions of unique plant species, many used for medicinal purposes. Forests cover 25% of the earth's land surface.	Since 1989, more than 20% of global forest cover has been removed due to conversion to other land uses and logging. Deforestation has significant impacts on biodiversity in the form of loss of unique plant and animal species. Forests act as carbon sinks.
Freshwater	Water sources covering less than 1% of the earth's surface are a primary source of water for drinking, domestic use, agriculture and industry, as well as an alternative source for fish.	Humans currently use more than 50% of all accessible fresh water runoff; by 2025 demand will reach 70%. Dams cause the loss of fisheries and biodiversity.
Grassland	Grasslands cover 40% of the earth's land surfaces and provide critical sources of protein and fiber from livestock. Primarily located in developing countries.	Roadbuilding, land conversion, and human induced fires have caused significant loss of grasslands and thus a loss of biodiversity.

Note: Reprinted from “Market imperfections, opportunity and sustainable entrepreneurship”, by Cohen, B. and Winn, M., 2007, *Journal of business venturing, 22*(1), 29-49.

The following section presents the birth of a new type of business that has environmental concerns as its main focus. Environmental Entrepreneurship is a trend that was born after these environmental issues became evident, and consists of a group of new ventures that did not "become" green but rather were "born" that way.

2.1.3 Environmental Entrepreneurship

Environmental entrepreneurship refers to activities that seek to promote environmental welfare and address various sustainability problems specifically while still being financially sustainable (O'Neil & Ucbasaran, 2016). In other words, ventures that have both the ecosystem and profitability as priorities. In this paper, environmental entrepreneurs include both necessity (innovating as means to live) and opportunity (innovating merely for the available opportunity) entrepreneurs.

Environmental entrepreneurs rise through the identification of opportunities that result from the degradation of the ecosystems. Thus, ecopreneurs follow the discovery view explained in section 1.1, as there is clear information asymmetry on how to do business while still protecting the environment. Dean and McMullen (2007) suggest that market failures such as externalities and public goods are a source of this type of opportunity. Unclear property rights concerning public goods such as water, earth, and air, have made them a target for polluting business practices. Dean and McMullen believe that ecopreneurs identify these gaps in the market and combine them with the pressure from stakeholders to create new businesses that are more environmentally friendly and profitable. Cohen and Winn (2007) focus their research into explaining that ecopreneurs identify market imperfections that lead to ecological challenges and innovate ways to help solve them.

Innovation from ecopreneurs comes in a new wave of creative destruction. Schumpeter (1982), introduces the concept as "process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one". This type of entrepreneurship is redefining production processes to be friendlier to ecosystems. Authors Hart and Milstein (1999) confirm the existence of this new sustainable wave by explaining that the age of corporations depending on the abundance of raw materials is coming

to an end, as impending environmental degradation is forcing businesses to rethink their technologies, products, and processes. In theory, these new methods should completely take over older ones and a new "greener" market should become the new norm.

A way environmental entrepreneurs can diminish environmental degradation and capture economic value is by reducing transaction costs associated with environmentally relevant externalities (Dean et al., 2007). However, even if entrepreneurs have many opportunities arising from these market irregularities, they still must comply with the formal institutions that are in place wherever they are to set their businesses. Authors Meek, Pacheco, and York (2010) explain that while previous research has been insightful in framing environmental entrepreneurship from an economic perspective (Cohen et al., 2007; Dean et al., 2007; Hart et al., 1999) they provide little understanding on how institutional context (rules, norms, boundaries, etc.) impacts the decision by an entrepreneur to exploit a given opportunity. These institutional norms vary across countries and can become an incentive or a deterrent for entrepreneurial activity. In the following section, literature explaining the relationship between formal institutions such as government, and environmental entrepreneurial activity is presented.

2.2 Formal institutions

Section 2.2 researches formal institutions such as the government and the role they play in policymaking. Furthermore, it finds how entrepreneurs and ecopreneurs alike are affected or constrained by these policies and must comply to survive in the market. This section ends with the formulation of two hypotheses that will help answer the research question presented in the introduction.

2.2.1 Entrepreneurship and formal institutions

Entrepreneurship is affected by the institutional environment of the country where the entrepreneur resides. New institutional theory confirms this statement by exploring the idea that actors pursue their interests constrained by rules set by institutions such as laws, social norms, and culture (Ingram & Silverman, 2002). Academics argue that environmental entrepreneurship can

be encouraged by government programs such as tax structure or a supportive culture (Lenox & York, 2011). On the other hand, other authors present evidence that government intervention can constitute a market failure. Dean et al. (2007) explain that the government may have negative impacts on environmental resources. This, however, is still a positive condition for environmental entrepreneurs as it creates an opportunity to fix the market inefficiency. In general, most governments try to direct economies to the most efficient and least environmentally impactful direction, specially today.

Society has been going through "ecological modernization", a movement where the actions of formal institutions are shifted towards greater ecological welfare and avoiding ecological crisis (Gibbs, 2009). This shift in thought has also created a shift in policymaking. This means that previous market failures created by subsidizing, for example, the extraction of natural resources (Dean et al. 2007) is being fixed by the government itself by moving resources towards more "green" policies and mixing environmental protection with economic development (Huber, 1985). According to Gibbs (2009), under the correct regulation support, a capitalist economy can develop sustainable solutions to market inefficiencies and "green" the market. Ecological modernization changes the expenditure customs of the government towards policies protecting the environment versus destroying it, which in the long to medium run will result in profit maximization for new industries even if in the short run it results in a loss for many already existing markets. These new type of regulations foment ecopreneurship activity.

There is proof that governmental support allows for a more conducive environmental goods and services industry (EGSI). For example, a study conducted by Russo (2003) proves that one of the reasons why the clean energy industry, specifically wind energy, is able to prosper in California, is because the state already offers a highly supportive environment for wind energy projects such as powerful tax incentives. He argues that institutional backing in the form of, e.g., public subsidies that augment private economic incentives also stimulate new industries, such as the one being studied in this paper. More recently, authors Criscuolo and Menon (2015) support this idea by writing that a higher level of government support for green entrepreneurship often corresponds to a stronger environmental orientation of entrepreneurs. They add that rule of law

and enforcement of environmental legislation increases the penalty for *not* being green, which in itself is an incentive for entrepreneurs to go down a greener route with their business methods.

Moreover, Linde (1995), confirms again that firms can benefit from properly crafted environmental regulations. The author adds that these regulations should come in the form of market incentives, such as pollution tax, deposit-refund schemes, and tradable permits. Linde states: "market incentives can encourage the introduction of technologies that exceed current standards." Meaning that market focused regulations bring new and better technologies towards a more sustainable economy versus a more static approach towards environmental policies.

All in all, one can assume that a more supportive public sector towards environmental businesses will affect the levels of environmental entrepreneurship (Meek, et al., 2010). The authors also emphasize that while the latter argument is believed true, the effect is highly affected by the overall social environment and its influence on entrepreneurial decision making. This leads to believe that the size of EGSI differs significantly in countries with notorious diversity in culture, thus country fixed-effects are considered in this study. Finally, Shane (2003) confirms that firm foundings are impacted by the economic and political context in which the potential entrepreneur is found. This paper focuses on proving these claims. The following section briefly describes existing government policies that target the improvement of environmental welfare.

2.2.2 Existing and popular environmentally friendly government regulations

In this section, the different types of regulation a government can implement to nudge businesses to have more sustainable practices are discussed.

The UN's World Economic and Social Survey of 2011 has a well-rounded overview of different policies to promote green innovation. It explains that a green national innovation system approach emphasizes incentives and policies directed towards the creation of market demand through the innovation cycle. These policies include feed-in-tariffs (payments made to citizens who create their energy through environmentally friendly practices), low-interest loans (to green entrepreneurial ventures to start-up), and public procurement.

This survey also emphasizes the importance of government association with new green businesses to incentivize the private sector to invest, as this type of innovation comes with high risk. Regulatory mechanisms such as targets or standards are also useful tools for the government to try and limit or prohibit certain behaviors. Among economists, price-based mechanisms are often preferred (such as taxes) even though they are harder to implement than quantity-based mechanisms, such as cap-and-trade (United Nations: Department of Economic and Social Affairs, 2011; Linde, 1995).

A common price-based mechanism to control pollution is the carbon tax or environmental tax. This type of tax is implemented in most industries in many countries and it is levied on the amount of carbon-based fuels burned by an enterprise. Table 2 shows more information on this tax as well as some of the most common government policies used to fight the degradation of the environment. Given that the environmental tax is one of the most common ways of tackling pollution made by different business organizations, it is a good estimator that can help answer the research question through the following Null Hypothesis ($H_{0,1}$) and its Alternative Hypothesis a1 ($H_{a,1}$)

- **Null Hypothesis 1 ($H_{0,1}$): There is no statistically significant association between environmental tax and the size of the environmental goods and services industry.**

- **Hypothesis a1 ($H_{a,1}$): Countries with higher environmental tax revenue show a larger size of the environmental goods and services industry.**

Besides an environmental tax, there are other efficient measure policymakers can impose to protect the environment, as shown in Table 2. The Organization for Economic Co-operation and Development (OECD) is an organization that helps shape policies that lead to a better lifestyle and they provide data on the Environmental Policy Stringency Index (EPS). They define policy-stringency as the policy-induced cost of polluting faced by firms, which can be explicit or implicit (Botta & Kozluk, 2014). The scale goes from 0 (less stringent) to 6 (most stringent) and compiles data from 1990-2012 from 28 OECD countries. More about the EPS index can be found in section 3 of this paper.

Table 2

Types of environmental policy

Type	Policy	Definition	Example
Quantity-based regulation	Targets	Environmental goals to be reached.	Renewable energy targets which set goals for green energy, usually at 5-20% of total energy consumption.
	Standards	Regulations for treatment or maintenance of the environment.	Energy-efficiency codes for buildings and air, water, and fuel efficiency standards.
	Outright mandates	An official order to do something	The Republic of Korea has a mandate that requires companies to recycle packaging
	Cap-and-trade	Limit to the amount of carbon dioxide a business can produce. However, these come as permits that can be traded between businesses to meet their optimal carbon emission level while still being within the limit the government set	European countries operate with a cap-and-trade program for almost two decades
Price-based mechanisms	Tax credits	Federal tax incentives for environmentally friendly practices	Green investment tax credits
	Feed-in tariffs	Payment to household or business generating their own clean energy	Payments to businesses that utilize solar panels
	Government procurement	Procurement of green goods by the government to increase market demand for this type of goods	Government procuring a fleet of green buses for public transport
	Carbon tax	A fee imposed on the burning of carbon-based fuels	Canada has a price of $15-$30 per metric ton of CO_2

Note: Adapted from United Nations: Department of Economic and Social Affairs. (2011). *World Economic and Social Survey 2011: The Great Green Technological Transformation*. And Plumer, B., & Popovich, N. (2020). These Countries Have Prices on Carbon. Are They Working?. Retrieved 15 June 2020, from https://www.nytimes.com/interactive/2019/04/02/climate/pricing-carbon-emissions.html

The EPS index is another tool that can help answer the research question, as it considers not only environmental taxes but also all other measures for enforcing greener policies on businesses. Thus, with this information a Null Hypothesis and Alternative Hypothesis a2 are formulated:

- **Null Hypothesis 2 ($H_{0,2}$): There is no statistically significant association between the environmental policy stringency index and the size of the environmental goods and services industry.**

- **Hypothesis 2 ($H_{a,2}$): Countries with a more stringent environmental policy stringency index have a bigger environmental goods and services industry.**

This paper analyzes how the implementation of strict environmental tax measures and strict overall policies affect the size of the EGSI. Below, the data that is used alongside the methodology to test the hypotheses is explained.

3. Data

This section of the paper presents all data that is utilized for the economic models in section 4. The data is acquired from the following sources: Environmental Business International, Inc and the Organization for Economic Co-operation and Development. This section also presents the countries and years that will take part in the study as well as any control variables needed to make the models fit and unbiased.

3.1 Dependent and Independent variables

The dependent variable in both analyses is the size (in millions of USD) of the EGSI converted to logs. This data is retrieved from the Environmental Business International, Inc (EBI) company. EBI is a publishing and research company that generates strategic market intelligence on emerging opportunities in the Environmental Industry, Climate Change Industry, and the Green

Economy (Ferrier, 2018). Taking the log from the absolute dollar value allows for the normalization of the sample distribution and makes all measures comparable.

EBI adds up the revenues generated by companies/entities in each of the environmental business sectors to determine individual segments and then total industrial size (Ferrier, 2018). From EBI, data from the years 2003-2016 is taken from 24 different countries. These countries are the ones chosen to be analyzed in the rest of this study and are the following: Argentina, Australia, Canada, Switzerland, Chile, China, Germany, Spain, France, United Kingdom, Israel, Italy, Japan, Mexico, Malaysia, The Netherlands, New Zealand, The Philippines, Poland, South Korea, Sweden, Turkey, The United States of America, and South Africa. This data is used to indicate the size of the EGSI throughout the years and in the aforementioned countries.

As for independent variables, they differ in models 1 and 2. This is because model 1 seeks to test hypothesis 1 and model 2 seeks to test hypothesis 2 which ultimately have different variables of interest. For the first model, the independent variable is the environmental tax, which is measured as a percentage of GDP. However, for this analysis, this relative measure is converted into an absolute measure by multiplying the tax revenue percentage from actual GDP for each country, and then the log value is taken from it. For the second analysis, the independent variable is the Environmental Policy Stringency Index (EPS). Both are further explained below. The data for both these variables is retrieved from OECD.

a. **Environmental tax**: this measure consists of tax revenue from environmentally related activities. More specifically, activities relating to "energy products (including vehicle fuels); motor vehicles and transport services; measured or estimated emissions to air and water, ozone-depleting substances, certain non-point sources of water pollution, waste management and noise, as well as management of water, land, soil, forests, biodiversity, wildlife and fish stocks." (OECD, 2020). As mentioned before, this data is transformed into absolute USD measures and after converted to logs.

   The OECD constructs this dataset by using the revenue from environmentally related taxes divided by the aforementioned domains. They specifically use the characteristics of such taxes (e.g. revenuer, tax base, tax rates, exemptions, etc.) to derive

the related tax revenue. The data is cross-validated and complemented with revenue statistics from the OECD Tax statistics database and official national sources (OECD, 2020).

b. **Environmental Policy Stringency Index (EPS)**: this is a measure of stringency of environmental policy in different countries. Stringency is defined as the degree to which environmental policies put an explicit or implicit price on polluting or environmentally harmful behavior. The scale goes from 0 (less stringent) to 6 (most stringent) and a country can receive a score of any number in between, including and most commonly non-integer values (Botta et al., 2014). This paper treats the EPS Index as a continuous variable as it can take an infinite amount of values between the parameters *a* (0) and *b* (6). They take into account market-based policies and non-market-based policies to calculate their scores. Table 3 shows the different policies that OECD utilizes in this index.

   After selecting their desired policy instrument, Botta et al. (2014) start their scoring process by creating instrument-specific measures of stringency – i.e. cardinal measures increasing in value as the stringency increases. For each instrument-specific indicator, both 0 and 6 are assigned with the thresholds for each class chosen based on the in-sample distribution of values on each instrument, in order words the cross country ranges of policies are standardized across instruments. Countries are scored each year according to how they perform against the individual classes (Botta et al., 2014). The EPS index is another tool that can help answer the research question, as it considers not only environmental taxes but also all other measures for enforcing greener policies on businesses.

Below the control variables are explained.

3.2 Control variables

To account for potential omitted variable bias in the data, two types of control variables are added: country and year dummies. These control for unevenness when it comes to country differences and time differences that may affect the size of the EGSI. These variables are collected

Table 3.

Instruments included in the EPS index

Instrument	Information considered for scoring
Emission Trading Scheme(CO_2)	Price of one CO_2 allowance
Renewable Energy Certificates Trading Scheme	% of renewable electricity that has to be procured annually
Energy Certificate Emission trading Scheme	% of electricity saving that has to be delivered annually
Emission trading Scheme for SO_2	Price of one SO_2 allowance
CO_2 tax	Tax rate in EUR/ ton
NO_x Tax	Tax rate in EUR/ ton
SO_x Tax	Tax rate in EUR/ ton
Feed In Tariff for wind	EUR/kWh
Feed In Premium for wind	EUR/kWh
Feed In Tariff for solar	EUR/kWh
Feed In Premium for solar	EUR/kWh
Particulate Matter Emission Limit Value for newly built coal-fired plant	Value of Emission Limit in mg/m^3
SO_x Emission Limit Value for newly built coal-fired plant	Value of Emission Limit in mg/m^3
NO_x Emission Limit Value for newly built coal-fired plant	Value of Emission Limit in mg/m^3
Government R&D expenditures for renewable energy technologies	Expressed as % of GDP
Tax on diesel for industry	Total tax for a liter of diesel used in transport for industry
Deposit & refund scheme	Dummy for presence of a Deposit Refund Scheme
Maximum content of sulfur allowed in diesel	Value dictated by the standard

Note: Adapted from "Measuring environmental policy stringency in OECD countries", by Botta, E. and Kozluk, T., 2014, *OECD Economics Department Working Papers*.

from EBI and OECD and work as categorical variables throughout the studied period and the selected countries for study. Similarly, authors Criscuolo and Menon (2015) also use year dummies as control variables as well as industrial sector dummies. In this case, industrial sector dummies can be substituted with countries dummies to account for differences between sampled nations.

With all the data collected, this paper continues with the following section delineating the methodology used to test the hypotheses.

4. Methodology

The methodology section presents the econometric method chosen to test hypotheses 1 and 2. It starts by explaining why the method was chosen, continues to explain the method, and ends with models 1 and 2 that contain the relevant data from section 3, such as the EGSI, EPS Index, and environmental tax in a regression that is fit to test the hypotheses.

4.1 Panel regression with fixed-effects

For this study, a panel regression with country fixed-effects is used. Panel data is a dataset in which entities are observed during a period of time. Panel data uses information from the same individual over the years. This type of data allows you to control for unobserved variables that may affect the entity's behavior, thus accounting for individual heterogeneity (Torres-Reyna, 2007).

A fixed-effects regression (FE) is useful in the context of causal inference. Usually, standard regression models provide causal estimates that are biased due to unobserved confounders (Brüderl & Ludwig, 2015). FE accounts for those unobserved confounders and provide unbiased causal estimates, that is if some assumptions are met. FE assumes that there is a correlation between the entity's error term and predictor variables (Torres-Reyna, 2007), this method removes the effect of those time-invariant characteristics so that predictors can yield an unbiased effect on the variable of interest.

Another assumption of FE is that the error term for each individual, in this case country, is unique to that individual. In other words, the characteristics that do not change over time for each country is unique to that place, these can be: culture, female to male ratio, belief system, etc. Since this study analyzes countries from all over the world, it is safe to say that this assumption holds, as time-invariant characteristics are likely to differ. If the error terms were correlated, then FE would have not been a suitable method since inferences derived from the model may not be accurate (Torres-Reyna, 2007).

4.2 The fixed-effects framework

Panel data is set up in a long format, meaning the observations of each country are ordered chronologically and the time panels of each subject are stacked below each other (Brüderl et al., 2015). One assumes that the outcome variable Y is continuous, and the K regressors $x_1 \ldots, x_k$ may be measured on any scale. A FE regression follows the equation below:

$$(1)\ y_{it} = x_{it}\beta + \alpha_i + \epsilon_{it}$$

Where y_{it} denotes the observed size of the environmental goods and services market of country i at time t, x_{it} is the independent variable, which in model 1 is the environmental tax revenues and in model 2 the stringency of environmental policy accompanied by β, which is x_{it}'s coefficient. Furthermore, α_i represents the stable country-specific characteristics, in other words, the time-constant country heterogeneity. Finally, $\in_{it}$ is the error term that varies across countries and over time.

In both analyses, an extra control variable is added to the original model to avoid omitted variable bias (OVB). This variable is a time dummy for each year in the sample data. These variables should capture year-specific characteristics. Similarly to country dummies, they represent time-constant year heterogeneity. Thus the updated model is the following:

$$(2)\ y_{it} = \beta_1 x_{it} + \alpha_i + \delta_t + \epsilon_{it}$$

Where δ_t stands for the year dummy for year *t*. However, to further control for outliers and non-normal distribution of the data, the log of the following variables is taken: EGSI and environmental tax. Thus, for a 1% increase in the independent variable, there will be a β_1% increase in the dependent variable. The final equations for model 1 and 2 are in the following section.

4.3 Model 1: using environmental tax revenue as independent variable

The first model is used to test for hypothesis $H_{0,1}$ and $H_{a,1,}$ the effect of higher or lower environmental tax policy on the size of the EGSI. To do so a panel regression with country FE is used. In this model, the log of the environmental tax is the independent variable and the time frame is from 2003 - 2016. The countries analyzed are the same as the ones presented in the data section of this study. The complete model is the following:

$$(3)\ \log(EGSI_{it}) = \beta_1 \log(Tax_{it}) + \delta_t + \alpha_i + \epsilon_{it}$$

Where:

- Log ($EGSI_{it}$): corresponds to the logged value of the environmental goods and services industry for country *i* on year *t,*
- α_i: the constant for country *i,*
- δ_t: the constant for year *t,*
- $\beta_1 \log(Tax_{it})$: the logged amount of tax revenue of country *i* at year *t* alongside its coefficient,
- ϵ_{it}: the error term of country *i* in year *t.*

The assumption for this model is that the higher the environmental tax revenue is, the larger the size of the EGSI. This is due to the belief that a country with stricter penalties for anti-environmental behavior would incentivize entrepreneurs to take greener methods when choosing business practices.

4.4 Model 2: using environmental policy stringency as independent variable

This model seeks to test for hypothesis 2 (H_2): whether stronger environmental policy implementation influences the size of the EGSI. To test this, the same method as before is utilized with a difference in the independent variable. In this case, OECD's EPS index is the independent variable, the years of study are from 2003–2012, and the sampled countries are the same as the ones mentioned in the data section of this study in exception of Argentina, Chile, Israel, Mexico, Malaysia, New Zealand, and The Philippines given the availability of data. The complete model is the following:

$$(4)\ \log\left(EGSI_{it}\right) = \beta_1 EPS_{it} + \delta_i + \alpha_i + \epsilon_{it}$$

Where:

- Log ($EGSI_{it}$): corresponds to the logged value of the environmental goods and services industry for country *i* on year *t,*
- α_i: the constant for country *i,*
- δ_t: the constant for year *t,*
- $\beta_1 EPS_{it}$: the stringency index for country *i* in year *t* alongside its coefficient*,*
- ϵ_{it}: the error term of country *i* in year *t.*

The assumption is that the higher the stringency index, the stronger positive effect on the EGSI, as the monetary penalties are a strong incentive for entrepreneurs to go green.

A third model with both environmental tax and EPS index with variables is not possible to include due to the over-controlling of tax values. The EPS index already controls for taxes relating to environmentally degrading activity, thus including both in a model will result in the over control for these types of taxes and yield biased results.

The following section presents the results derived from model 1 and 2.

5. Results from Models 1 and 2

This section presents the output tables of the models derived from the statistical program Stata. Section 5.1 contains the results for Model 1 which tested a panel regression with country and year fixed-effects to see the relation of environmental tax and the size of the EGSI. Section 5.2 presents the results derived from Model 2 which was also a panel regression with country and year fixed-effects that sought to find the relation between the EPS index and the size of the EGSI.

5.1 The effect of environmental tax on the size of the environmental goods and services industry

Results from Model 1 shine a light on the answer for the research question. $H_{a,1}$ suggests that there should be a positive relationship between the size of the EGSI and the environmental tax collected. Countries collecting more environmental taxes should have stronger policies against these anti-environmental practices which drive more entrepreneurs towards a greener path. This is confirmed with the results, Table 4 shows that there is a positive relationship between the size of EGSI and the environmental tax revenue collected accounting for country and year fixed-effects. For every 1% extra of environmental tax collected, the EGSI grows by approximately 23%. This association is statistically significant at the 1% level with the log(Tax) variable having a p-value of 0.000 and a coefficient of 0.228. These results indicate that $H_{0,1}$ is rejected, as there is a positive statistically significant relationship between the dependent and independent variables, favoring $H_{a,1}$. However, it is important to point out that an increase of 23% in the industry seems massive to just be attributed to environmental tax. This suggests that there are other variables that have an effect on the results that were not included in this model.

5.2 The effect of the environmental stringency index on the size of the environmental goods and services industry

Hypothesis 2 suggests that countries with a stricter penalty system will have a bigger EGSI. Results shown in Table 4 show the aforementioned but are inconclusive due to their statistical insignificance and the small size of the coefficient. The EPS variable shows a positive coefficient,

suggesting that the higher the level of stringency a country has, the larger the size of their EGSI in millions of dollars. Unfortunately, when controlling for country and year fixed-effects, this coefficient turns statistically insignificant at the 5% level with a p-value of 0.884 and a small coefficient value of 0.003. Thus, $H_{0,2}$ cannot be rejected. There is no statistically significant relationship between the EPS index and the size of the EGSI and the existing positive relationship is most insignificant, for every increase in the EPS index point, there is only a 0.003% increase in the size of the EGSI.

Table 4.

Panel regression with country and year fixed-effects of the relationship between environmental tax and the EPS index on the size of the environmental goods and services industry

Variable	Model 1	Model 2
Tax	0.228***	
	(0.054)	
EPS index		0.003
		(0.019)
Observations	329	170
R^2	0.9943	0.9950

Note: Standard errors in parentheses. Country and year dummies have been removed from the table. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6. Discussion and Conclusion

In this paper, two hypotheses were analyzed to help answer the central research question as to whether governmental incentives were affecting the size of the EGSI around the world. The results obtained from the analyses in both models 1 and 2 confirmed what previous literature

already states: governmental interventions have an effect on the size of the industry for environmentally friendly businesses.

It was believed that a higher environmental tax revenue would suggest a bigger EGSI in a given country. This is proved by the results, given the positive statistical relationship between the EGSI and the environmental tax collection, meaning that entrepreneurs do respond to higher penalties for un-environmental practices and decide to make their business practices green, thus the increase in the size of the EGSI.

On the other hand, the second hypothesis included more types of environmental policies in model 2. It explored whether countries that were more stringent than others when it came to the enforcement of these policies affected the size of the EGSI. Although the results for this analysis were not statistically significant, there is still a positive association between the EPS Index and the EGSI. These results suggest that the more strict countries are in enforcing these policies, the more "green" new and existing businesses will become. Unfortunately, these results cannot prove a strong relationship because the size of the coefficient was close to zero, but give space for further study in this area to try to identify which policy is more effective besides the already proven environmental tax.

It is of utmost importance to include the fact that this paper solely spoke on association and not causality due to an issue with reverse causality. With the available data, there was no possible way to prove that the EPS Index or tax revenues *caused* a larger size of the EGSI or if a larger EGSI *caused* more policy creation. Thus, this paper proved that there is a relationship, however, it did not dive into understanding the direction of said relationship.

In conclusion, the effect of government incentives can only be statistically proven through environmental tax revenue, presenting evidence of a positive relationship between the size of EGSI and the amount of tax revenue. This answers the research question given that government incentives are affecting the number of environmental ventures. Also, there is a positive correlation between the size of the EGSI and how stringent countries are in enforcing policies, which also answers the research question as well by giving further support to the previous statement.

However, this association is not statistically significant or strong. This paper thus supports the work of academics who have previously investigated the same topic (Criscuolo et al., 2015; Dean & McMullen, 2007; Linde, 1995; Gibbs, 2009; Meek, Pacheco, & York, 2010, and others).

Future policymakers can take the results from this study and apply them to the creation of new regulations. What the results suggest is the effectiveness of policy regarding tax. Governments can start enforcing stricter tax penalties for pollutant businesses to increase the size of the EGSI and to further stimulate that industry. The results of model 2 show that it is optimal to have any type of environmental protection policy in place rather than none to grow the EGSI and by consequence decrease un-environmental practices.

It is important to present the limitations of this research. Firstly, the use of a panel regression with country and year fixed-effects has its limitations. This method cannot account for time-variant characteristics that may affect the dependent and independent variables. Furthermore, there may be other variables that have to be controlled to get less biased results that were not included in this analysis, especially for model 1. These may be entrepreneurial education, the cost of starting a new business, culture, etc. It is recommended that these are included in future research to get more robust results. In addition, for H_2 the data was limited, and the number of countries and years analyzed was smaller than for H_1. In the future, a more similar group should be used to test both hypotheses. Other limitations include the short time for research, as there were only three months available to fully complete this paper. More time would have improved the quality of the data collected and might have solved the OVB that the models present at the moment. Finally, there is a lack of literature about this topic from the past 10 years. This means that most of the work presented in the theoretical framework is based on older literature that may be outdated. It is recommended for future researchers to find academic work with a more updated view on the matter to get more accurate results and interpretations.

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