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The Relationship Between Environmental Policy Stringency and Trade Flows

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Abstract: Ceteris paribus, it is unclear whether a more stringent environmental policy increases or decreases a country's competitiveness. Two hypotheses have been formulated in this decade-long debate: the competitiveness hypothesis – stating that a more stringent environmental policy decreases competitiveness, and the Porter Hypothesis, claiming the opposite. Previous research has studied this relationship between environmental regulation and trade flows at the firm and industry levels. However, few studies to date have been done from a macroeconomic perspective. Employing an instrumental variable strategy in which we exploit the exogenous variation in the ventilation coefficient as an instrument for policy stringency and a panel data set of 33 countries between 1990 and 2020, we attempt to fill this gap. In neither our OLS estimates nor our IV estimates do we find any statistically significant results supporting the competitiveness hypothesis or the Porter Hypothesis. Instead, our results suggest that other determinants of net imports are much more important, such as labour share, tariff rates, FDI and factor abundance.

Keywords: environmental policy stringency, trade flows, competitiveness hypothesis, Porter hypothesis

JEL: F18, Q52, Q56, Q58

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Table of Contents

1. Introduction *3*

1.1 Relevance of the Topic 3

1.2 How this is Investigated 4

2. Background *5*

2.1 Theoretical Background 5

2.1.1 Traditional Economic Theory 5

2.1.2 The Pollution Haven Hypothesis and the Competitiveness Hypothesis 5

2.1.3 The Strong Version of the Porter Hypothesis 6

2.2 Previous Literature 8

2.3 Research Gap, Contribution and Research Question 10

3. Empirical Specification and Data sources *11*

3.1 An Instrumental Variable for EPS - the Ventilation Coefficient 13

3.2 A Measure of EPS - the Environmental Policy Stringency Index 15

4. Empirical Strategy and Results *17*

4.1 OLS Baseline Estimates 17

4.2 Instrumentation Strategy 19

5. Discussion and Limitations *24*

5.1 Weak Instrument Bias 24

5.2 Aggregation Issues 24

5.3 Data Limitations 25

6. Conclusion *26*

References *27*

Appendix *31*

1. Introduction

1.1 Relevance of the Topic

In light of the increasing shift of focus among governments globally toward environmental outcomes, many environmental policies have been introduced. These regulations may either be market-based, meaning that they aim to increase the opportunity cost of polluting or be non-market-based, meaning that they are enforced rather than built on price mechanisms. As with many other regulations, these policies will - besides the environment - also affect economic activity in various ways, ranging from production processes and input compositions to innovation incentives (Albrizio et al., 2017). Another example of such an activity is how environmental policies affect international trade flows. During the past decades, a positive trend of higher environmental standards can be seen among most OECD and the BRIICS (Brazil, the Russian Federation, India, Indonesia, China, and South Africa) countries (see Figure 1 in the Appendix). This, while global trade has also seen a positive trend and is now recovering from the COVID-pandemic (OECD, 2022a).

Regarding the theoretical implications of the relationship between environmental policies and trade flows, a much-heated debate is whether increased environmental policy stringency hurts country-level competitiveness or enhances it. Here, stringency is defined as the cost imposed on firms' polluting activities or any other activity harming the environment. Henceforth, environmental policy stringency is referred to as EPS.

On the one hand, a higher EPS could hurt the profits of affected firms, in line with traditional economic theory, implying a competitive disadvantage for those industries affected – that is, there is a trade-off between stringency and economic output (Koźluk and Zipperer, 2014). On the other hand, Porter and van der Linde (1995) proposed that environmental policies - if "properly designed" - can offset the compliance cost of the policies and even turn to a competitive advantage by inducing innovation among firms to reduce pollution activity which often means being more productive in general. Suppose, then, this reasoning holds at the country level, so domestic industries become more competitive. In that case, we should see a decrease in net imports as the domestic firms increase their competitive advantage vis-à-vis foreign firms through the innovation induced by stringent environmental standards. For policymakers, this would imply a free lunch: increasing domestic firms' competitiveness while simultaneously caring for environmental performance by being able to enact stricter policies – satisfying both the economy and the environment.

This relationship between EPS and polluting industries' competitive advantage has been theoretically and empirically investigated for some decades, with Tobey (1990) being one of the pioneering studies. Today, significant evidence supports the hypothesis that increased domestic EPS decreases competitiveness. This is called the competitiveness hypothesis (or the pollution haven effect) in the literature.

Against this background, we aim to put the competitiveness hypothesis (CH) to the test at the country level. If this doesn't hold, we would instead have found indicative results in favour of Porter and van der Linde's hypothesis, also known as the "Porter's Hypothesis" (PH). To do this, we apply a similar logic as previous papers, namely, that if more stringent regulation makes firms less competitive, the most regulated industries will exhibit the highest import penetration (Tobey 1990; Grossman and Krueger 1994). However, to understand the relationship between EPS and trade flows on a macro level, we use this logic on the country level instead, enabling us to generalise results beyond specific firms and industries and across countries. If the CH holds, the most regulated countries will exhibit the highest import penetration.

1.2 How this is Investigated

Using a simple international trade model (see Section 2), we extend the work of Ederington and Minier (2003), Levinson and Taylor (2008) and Broner et al. (2012) by investigating the impact of environmental regulations on net imports from dirty industries. We do this by employing an instrumental variable strategy with the ventilation coefficient as an arguably relevant and exogenous variable that we apply on the macro level.

Moreover, we use OECD's Environmental Policy Stringency (EPS) Index as a proxy for the stringency of environmental regulations (OECD, 2022b). This index is a composite, country-level measure of environmental regulation that allows for cross-country comparisons. Together with Net Imports from dirty industries (modelled as a % of GDP) and control variables (FDI, GDP/capita, tariff rates, and oil abundance), we construct a panel data set containing 27 OECD countries and the BRIICS countries between 1990 and 2020.

1.3 Key Results

In neither our OLS estimates nor our IV estimates do we find any statistically significant results to affirm that there is a relationship between EPS and net imports from dirty industries. As such, our results do not provide any support for the competitiveness hypothesis or the Porter Hypothesis. Instead, we suggest that other determinants of net imports are much more important, such as labour share, tariff rates, FDI and factor abundance.

2. Background

2.1 Theoretical Background

2.1.1 Traditional Economic Theory

Traditional economic thinking would posit that a more stringent environmental policy would decrease profitability for the firms affected. Environmental policies can impossibly increase profitability because if, e.g., more environmentally friendly production processes would improve firm performance, these processes would have already been in place - irrespective of environmental policies. As such, environmental policies mean increased restrictions on production, which results in firms having to allocate resources toward pollution abatement or curbing their production. In short, environmental policies do not generate value added in the short to medium run (Koźluk and Zipperer, 2014).

Furthermore, on the industry level, the higher costs caused by environmental policies may act as entry and exit barriers, reducing competition and "[…] shielding potentially inefficient incumbents and obsolete capital stock, thereby leading to lower productivity levels and growth" (Koźluk and Zipperer, 2014) All in all, there is a trade-off between environmental regulations and economic output.

2.1.2 The Pollution Haven Hypothesis and the Competitiveness Hypothesis

One of the most researched phenomena regarding the relationship between environmental policies and trade flows is the pollution haven hypothesis which states that, as trade is more liberalised, pollution-heavy firms and industries will move to jurisdictions with less stringent environmental policies. For this hypothesis to hold, both the competitiveness hypothesis (that higher EPS hurts the competitiveness of domestic, polluting firms) must be correct, as well as the fact that laxer environmental policy must yield a comparative advantage among polluting firms, which makes them move production to another jurisdiction (Copeland, 2013).

Against the background of traditional economic theory, the competitiveness hypothesis (CH) states that an increase in domestic EPS reduces the domestic competitiveness of affected industries (Copeland, 2013). The relationship the hypothesis describes can be seen in the diagram below. Figure 2 illustrates a partial-equilibrium model of a country in a free-trade setting that imports goods from a polluting industry. D represents domestic demand; S^0, is the initial domestic supply; p, is the world price; and M_0, is the initial imports. Given that the increased EPS will increase the domestic firms' costs, the supply curve shifts to S^1, which results in increased imports, corresponding to M_1. These shifts represent how domestic firms lose competitiveness due to an increase in EPS, which implies increased import penetration from foreign competitors not affected by the more stringent regulation.

Partial-equilibrium model

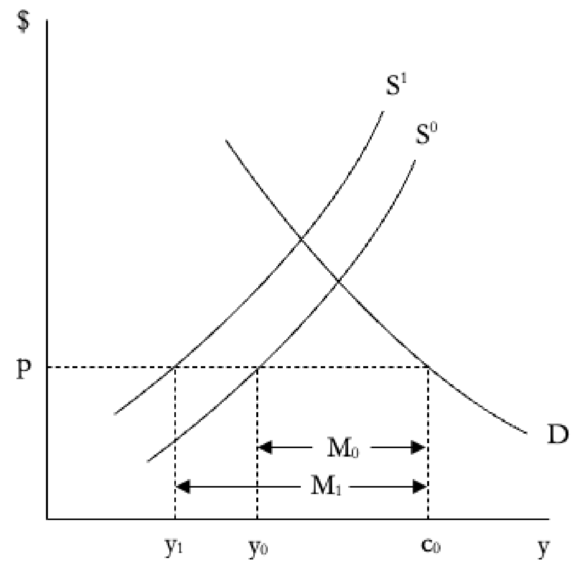

Figure 2
Source: Based on Copeland (2013)

2.1.3 The Strong Version of the Porter Hypothesis

As previously mentioned, the Porter's Hypothesis stands in contrast to standard economic theory in that more stringent environmental policies will increase, or at least not hurt, the competitiveness of firms subject to it. This is because the environmental policy represents compliance costs that induce firms to innovate to circumvent these. Implicit in this reasoning is the assumption that

"[…] there are profit opportunities for firms which are not fully used until firms are pushed to do so by the implementation of a new environmental policy" (Koźluk and Zipperer, 2014). This assumption about market imperfection thus breaks with traditional economic theory in which firms always maximise profits. This increased innovation, in turn, increases profits and, therefore, firm competitiveness because of cost savings. Effectively, this means that the firms subject to a specific environmental regulation could obtain a comparative advantage vis-à-vis foreign competitors that are not subject to the regulation. The above corresponds to what is called "the strong version" of the Porter Hypothesis in the literature.

In contrast, the "weak version" states that policy compliance "[…] will lead to an increase in environmental innovation" (Koźluk and Zipperer, 2014). Finally, the strong version contrasts with the "narrow version" of the Porter Hypothesis, which states that certain types of environmental regulation, such as market-based instruments, "[…] are more likely to increase innovation and improve company performance" (Koźluk and Zipperer, 2014). Hereafter, the strong version of the Porter hypothesis will be referred to as the Porter hypothesis (PH).

The strong version of the PH is illustrated in Figure 3 below, with the same denotations as Figure 2 above, but with the opposite chain of effects; as the competitiveness of domestic firms increases as a result of EPS, the domestic supply curve shifts outward, which in turn decreases imports.

Partial-equilibrium model

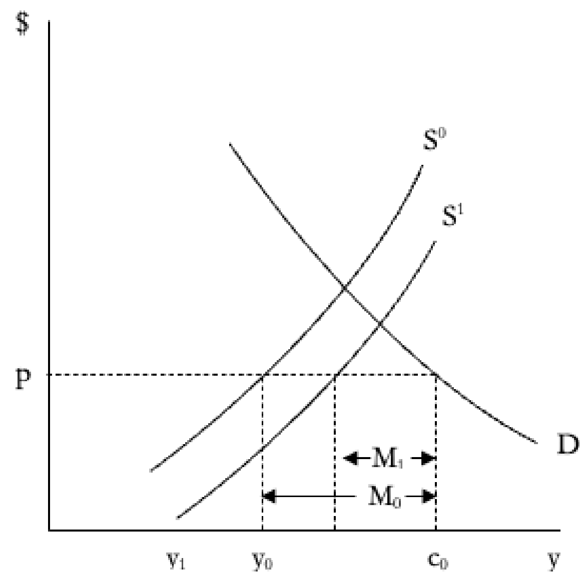

Figure 3

Source: Based on Copeland (2013)

2.2 Previous Literature

In the past few decades, a growing body of evidence investigating the competitiveness hypothesis has emerged. According to Copeland (2014), most of this literature addresses production-generated pollution in the manufacturing sector. Early literature, such as Tobey (1990) and Grossman and Krueger (1994), used cross-sectional data and did not find any significant results supporting the CH. Jaffe et al. (1995) found a negative relationship between EPS and net imports, supporting the Porter hypothesis.

What is common among this earlier literature, however, is the fact that environmental policy is taken as given. As Ederington and Minier (2003) point out, the modelling of environmental policy as exogenous builds on the assumption that trade considerations never determine this policy. One reason why trade considerations may lead to a shift in EPS is a political economy theory: Ederington and Minier explain that "[…] if countries tend to (endogenously) relax environmental regulation on those industries facing strong import competition, then net imports and the level of environmental regulation may appear to be only weakly correlated across industries, even if stringent environmental regulations are a major source of comparative disadvantage". In the same line of reasoning, it could be in countries' strategic interests to protect domestic industries by weakening EPS as a substitute for conventional trade policy instruments (in cases where trade agreements imply that conventional instruments cannot be used), which would work as a subsidy for domestic producers (Copeland, 2021).

Because this later research, starting with Ederington and Minier (and then adopted by, e.g., Broner et al. (2012), models environmental policy as endogenous, the methodological issue of reverse causality arises. Ederington and Minier solve this by using a system of simultaneous equations, including a vector of political economy variables (such as industry size as a proxy for political importance) as an instrumental variable for EPS while using a vector of factor intensity variables as an instrument for the level of net imports. Thus, the authors find exogenous variation in both EPS and net imports.

Another methodological complication arises when deciding on what measure to use for the stringency of environmental policies. Most of the current literature uses proxies that, in some regard, lack reliability (Koźluk and Zipperer, 2014). These include, among others: plant-level expenditures, "shadow prices", and company-level perceptions of EPS. This reliability issue is especially important regarding cross-country comparability, which is why the researchers at OECD have developed the EPS Index (Botta and Koźluk, 2014), where environmental policy instruments are scored and then aggregated to total EPS scores for a set of OECD and the BRIICS countries. The EPS Index will further be described under Section 3.2.

Going back to the abovementioned studies and the evidence generated regarding the CH, Ederington and Minier use data on pollution abatement costs (as a proxy for EPS) in U.S. manufacturing industries and find support for the endogeneity of environmental policy as well as for the CH. Specifically, they find that import penetration increases by 30 percentage points for every percentage point increase in pollution abatement costs.

Levinson and Taylor's paper (2008) is another example of a study using the IV approach with a panel data set. They use pollution abatement costs in 130 different US manufacturing industries and export and import data between 1977 and 1989 to estimate the effect of EPS on US trade with Canada and Mexico. Moreover, they construct an instrument based on the geographic location of industries across the US. These authors also find evidence for the CH, especially when using a panel-IV approach, in contrast to simply a panel approach, by which the effect was smaller. The above examples of IV strategies do consider the issue of endogeneity and the resulting reverse causality. Nevertheless, Broner et al. (2012) summarise the previous studies using IV by stating that these have "[…] not yet provided evidence of the pollution haven effect due to the difficulties in finding valid instrumental regulation". To resolve this issue, they use a meteorological air pollution model to validate the so-called "ventilation coefficient" as an instrument, which they argue is an instrument for EPS that satisfies the conditions of exogeneity and relevance.

Next to cross-sectional data, panel data, and instrumental variables, some studies employ single-policy events to uncover the causal effect of environmental policy on trade flows. This has allowed for studies wherein relying on proxies for EPS is not necessary, which means that: (1) measurement error could be reduced; and (2) researchers are allowed "[…] to highlight the particular institutional details that drive variation in regulatory stringency across firms or industries" (Cherniwchan and Taylor, 2022). These two points, in turn, imply that the required identifying assumptions become evident. An example of such a study is Cherniwchan and Najjar (2022), who employ a triple-difference research design to exploit the quasi-experimental variation caused by a change in the Canadian air quality regulation to evaluate its effect on manufacturing plants' export. They find that increased regulation decreased exports markedly among manufacturers affected by it.

Although single-policy studies are methodologically sound, it is unclear how they contribute to understanding whether the CH holds. This is because the findings often relate to the firm level and specific policies, which means that the results are hard to generalise at an industry level.

All in all, recent studies point in the same direction – that is, in support of the CH, implying that the pollution-heavy industries' competitiveness suffers from more stringent environmental policies. Worth noting, however, is that the magnitude of the effects in favour of the CH is more ambiguous. Finally, it is also important to call attention to the fact that these effects, although ambiguous, are not large, which indicates that firms' abatement costs are small compared to the overall costs.

2.3 Research Gap, Contribution and Research Question

First, several accounts call for more research on the topic (e.g., Copeland, 2013; Albrizio et al., 2014; Copeland, 2021; Cherniwchan and Taylor, 2022). For instance, Copeland (2013) notes that much of the current literature uses U.S. data and thus welcomes international data on the relationship between environmental policy and trade flows. This limitation can partly be attributed to the fact that there has been a lack of proxies for EPS that allows for cross-country comparisons.

Moreover, most studies to date study the relationship of interest on a firm- or industry-level, often regarding a specific industry and specific environmental laws. This leads to a need for more generality in current findings. In other words, few papers have a macroeconomic perspective which, per definition, allows an investigation of the relationship on a more aggregate level, making findings more generalisable.

Considering the above, we aim to fill the research gap using a newly developed EPS proxy, the EPS Index (Koźluk and Zipperer, 2014). Combining this index and its latest data from 2020 with a sample of 33 countries' net imports from dirty industries, we expand on current literature by estimating the causal relationship of EPS on net imports.

Furthermore, to the best of our knowledge, there has yet to be research on the relationship between net imports and EPS between the three-decade-long period of 1990-2020. Previous papers have only been able to study the years up until 2015, so including the following five years allows us to exploit more considerable variance.

Our contribution to the literature is thus three-fold: (1) we adopt a macro-economic perspective, allowing for a broader generality of our conclusions; (2) we are the first to apply the new 2020 data of the EPS Index, a proxy allowing for a cross-country examination; and (3) we add another estimate of the CH, contributing to our understanding of the extent to which the pollution haven hypothesis may hold.

Research Question:

What is the effect of environmental policy stringency (EPS) on net imports of dirty industries?

Hypotheses:

To answer the above research question, we formulate the following hypothesis: H_0: No significant relationship exists between EPS and net imports from dirty industries.

H_1: A significant relationship exists between EPS and net imports from dirty industries.

3. Empirical Specification and Data sources

To test the competitiveness hypothesis, we use a panel data set comprising 884 observations in 8 variables for 27 OECD countries (Australia, Austria, Belgium, Canada, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Mexico, the Netherlands, Norway, Poland, Portugal, Slovakia, South Korea, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States), and the BRIICS (Brazil, Russia, India, Indonesia, China, and South Africa) for the years 1990 – 2020.

Specification-wise, we take inspiration from previous literature (Ederington and Minier, 2003; Kim and Lin, 2022; and Broner et al., 2012) on the relationship between environmental regulation and trade flows. Extending their work, but with the aggregation at the country level, we design our empirical specification as the following:

$$M_{it} = \beta_1 * EPS_{it} + \beta_2 * F_{it} + \beta_3 * \tau_{it} + \beta_4 * GDP_{it} + \beta_5 * FDI_{it} + \beta_6 * Oil_{it} + \mu_i + \mu_t + \varepsilon_{it} \text{ ----(1)}$$

where M_{it} is the aggregated net imports (imports – exports) of dirty industries in country i in period t; and EPS_{it} is the environmental policy stringency. Furthermore, we use other controls such as an average weighted tariff rate variable (τ_{it}), net FDI inflows, (FDI_{it}), factor abundance, (F_{it}), GDP per capita (GDP_{it}), and oil abundance (Oil_{it}) . In Equation (1), we also include country and time fixed effects depicted by μ_i and μ_t, respectively. If the competitiveness hypothesis holds at the country level, then $\beta_1 > 0$.

Learning from previous studies (e.g., Ederington and Minier, 2003; Levinson and Taylor, 2008; and Broner et al., 2012), a central aspect of our empirical strategy is to account for the possibility of reverse causality and simultaneity (this is elaborated on in section 4.2). Thus, as in many previous papers, we employ an instrumental variable strategy. This means we need to find an instrument for our EPS variable that provides exogenous cross-country variation in EPS but does not affect the other predictors of net imports. As such, we can say that the exogeneity and relevance requirements for an IV approach are met, and we would thus deal with the issue of reverse causality. This, in turn, means that we can causally interpret a potentially significant EPS as the effect of EPS on net imports of dirty industries on a country level. The employed instrumental variable, the ventilation coefficient, will be further discussed in Section 3.1.

Going back to our specification, we follow the literature praxis by scaling net imports to the specific GDP of a country to make the effect of EPS on net imports comparable across countries. Following previous literature, we have included a control for tariffs. Since we conduct our study on a macro level instead of an industry level, we use the weighted mean applied tariff, which is defined as "[…] the average of effectively applied rates weighted by the product import shares", and the tariff data used is sourced from Our World in Data (2022). GDP and GDP per capita figures are taken from the OECD (2022c; 2022d). GDP per capita is included to account for the positive relationship between country-level income and EPS – as countries become more affluent, they also tend to enact more stringent environmental regulations (Kim and Lin, 2022). The FDI net inflows (as a share of GDP) data is taken from The World Bank DataBank (2022). Including this control is based on Kim and Lin's paper in which they argue, based on the pollution haven hypothesis, that governments may lower EPS to attract foreign capital.

Furthermore, as Ederington and Minier (2003) argue, we include a factor abundance variable, F_{it}, to control for relevant endowment differences between countries. We use the country-level labour share as a proxy for this, and the data is retrieved from the Federal Reserve Bank of St. Louis (2022). Oil abundance, which is utilised as a control for the import market share in Broner et al., (2012), is used to control for resource abundance and is proxied in this paper as Oil per capita which is sourced from Our World in Data (2022).

We follow Tobey (1990) regarding dirty net imports by investigating the CH based on the trade of pollution-intensive (or dirty) industries. In Tobey's paper, pollution-heavy industries are defined as "[…] the products of those industries whose direct and indirect abatement costs in the U.S. are equal to or greater than 1.85 percent of total costs". These industries are then matched with 3-digit SITC (Standard International Trade Classification) codes, which comprise five industry groups. In contrast to this approach, we imitate Tantri and Bhat (2022), who define pollution-intensive industries based on goods' emission intensities and instead use SITC codes based on the SITC Revision-3 classification. According to these authors, the two approaches do not differ significantly regarding the final list of pollution-intensive industries. The industry list provided by Tantri and Bhat, who, in turn, have followed Mani and Wheeler (1998) and Broner et al. (2012), includes 16 industry categories. This list, which has been used as a reference for our study, can be found in Appendix 2. The export and import data for these SITC codes in the countries included in the present study has been collected from the UN Comtrade Data Base (2022). For each country, this industry data has been aggregated at the country level and then, net imports have been calculated by subtracting total exports from imports.

To complete our IV specification, we need to: (1) obtain a measure of EPS; and (2) obtain a variable that provides exogenous cross-country variation in EPS.

3.1 An Instrumental Variable for EPS - the Ventilation Coefficient

Drawing on Broner et al.'s (2012) IV strategy, we use the ventilation coefficient (VC, also called the *ventilation factor* or the *air pollution potential* in the meteorological literature) as an instrumental variable for EPS. The ventilation coefficient is the product of wind speed and mixing height and is exogenously determined by weather systems which, in turn, influence pollution dispersion in urban areas.

To construct a VC data set, wind speed and mixing height data was sourced from the European Centre for Medium-Term Weather Forecasting (ECMWF) ERA-5 (Hersbach et al., 2019). The data is provided globally in longitude-latitude grids of $0.75° \times 0.75°$, corresponding to circa 83 square kilometres. We obtain the monthly averaged values for wind speed (at 10 meters above the ground) and mixing height (in meters above the ground) and then subsequently take the 12-month average for the grid closest to the coordinates of the capital city of every country to get a yearly time series from 1990-2020. The benefit of using capitals as proxies for their respective countries is that our study looks at manufacturing industries that often operate in urban areas. To ensure that the capital city is a good proxy for the ventilation coefficient of a country, we refer to robustness checks done by previous literature (Broner et al. 2012) which indicates that the VC for the entire country has a significant correlation of 0.91 with the VC of the capital city.

Theoretically, the instrument's relevance is best explained through the illustration of a simple Box Plot which predicts air pollution concentration in a three-dimensional space (Broner et al. 2012). The base of the box is determined by the square land area (L) from which (P) units of pollution are dispersed per unit area. The box height is the mixing height (b), and the perpendicular wind speed is (u). In a steady state, the average air pollution concentration (Z) is thus given by the equation below:

$$Z = \frac{L}{2} \times \frac{P}{b \times u}$$

As mentioned before, the ventilation coefficient is the product of mixing height and wind speed, which is inversely related to pollution concentration, as seen in the above equation. Practically, increasing the mixing height or wind speed increases the effective volume in which pollutants are allowed to mix - thereby reducing pollution concentration.

Similar to Broner et al.'s (2012) theoretical model and approach, we would assume that environmental regulations would be less stringent in countries where pollution is easily dispersed (high VC). This is bolstered by their results, where the ventilation coefficient (based on exogenously determined meteorological characteristics) is a strong predictor of a country's environmental regulation level. This means that even though two countries may pollute the same amount, one country may have higher EPS due to less dispersed pollutants in their atmosphere.

In our analysis, we find that the ventilation coefficient is a significant predictor of the EPS Index while also weakly correlated with other determinants of net imports, such as factor abundance. We discuss and present the findings of our empirical analysis and continue the arguments for the instrument's relevance in Section 4.2.

3.2 A Measure of EPS - the Environmental Policy Stringency Index

As a proxy for the stringency of environmental policy, we use OECD's Environmental Policy Stringency Index released in 2014. The choice of proxy is based on the conviction that it is, to date, the least imperfect proxy for environmental regulation stringency in the context of cross-country comparisons over relatively long periods.

Earlier research has used a variety of proxies, such as measuring businesses' perception of stringency or measuring their pollution abatement costs (see, e.g., Ederington and Minier, 2003) – both through surveys sent out to the businesses. Other examples include environmental performance data such as relative pollution intensity (see, e.g., Brunel and Levinson, 2013); and "shadow pricing", which implies estimating the price of pollution. According to Botta and Koźluk (2014), the creators of the EPS Index, these proxies are unsatisfactory since they have shortcomings related to at least one of the main challenges when measuring environmental regulation stringency. These are: "[…] multi-dimensionality, sampling, identification (and enforcement) and the lack of data […]" (Botta et al., 2014).

First, regarding multi-dimensionality, there are regulations covering different environmental media (e.g., air, water, and land), different pollutants concerning each media, and different types of instruments with varying designs per regulation. These need to be weighed and aggregated. Second, there are sampling issues in that the regulations may determine the sample of industries and firms. For instance, the composition and existence of industries and firms in a particular jurisdiction could be a direct cause of the regulation as industries and firms enter and exit as a cause of the regulation. Third, regarding the measures of, e.g., pollution abatement cost, pollution intensity and shadow pricing, it is hard to single out the effect of environmental regulation from that of other types of regulation as well as other economic factors, such as technology access and trade openness. This bias is also relevant to the abovementioned surveys, which are subjective and thus inextricably biased to some extent. Moreover, there are discrepancies between de jure and de facto regulation since the enforcement of these regulations varies across jurisdictions - another aspect that must be considered when proxying stringency. Finally, there is a lack of data which is "[…] often quoted as one of the reasons for preferring one type of measure of stringency over others." (Botta et al., 2014).

To tackle these challenges, the authors first construct the index for the energy sector only since its importance is broadly similar across countries and time. By first starting with the energy sector - which is rarely involved in other activities than producing electricity - the authors assume that environmental regulations imposed on this sector are only directed towards the activity of electricity production. As such, environmental policy stringency can be estimated by looking only at these regulations. Important to note is that the authors exclude nuclear and hydro energy since the policies concerning these types of firms are complex and do not only involve policies regulating electricity production. Furthermore, since the energy sector stands for a large part of greenhouse gas emissions in most countries, there is more extensive data on the energy sector compared to other sectors. Fifteen different instruments of environmental regulation are scored and aggregated for this sector.

The index is then extended to an economy-wide index by adding the transport sector, which adds another three instruments to the index, and "[…] a dummy on the existence of deposit and refund schemes". The authors argue that this improves the representativeness of environmental policy stringency on the economy-wide level, based on the assumption that included instruments represent the stringency of other environmental policies in the economy at large. The issue of multi-dimensionality is, e.g., dealt with by the estimation of regulation in different sectors since these relate to different environmental externalities. The authors write:
"Adopting a sectoral approach implicitly assumes that the overall stringency of environmental regulations can be approximated by looking at policy instruments that regulate environmental externalities in selected sectors. The underlying assumption is that policy control of environmental externalities in a given sector (e.g., energy, transport) implies a similar degree of policy control for the same externalities in other sectors. While this may not always be the case due to political economy issues (e.g., lobbying power of sectors) or international obligations, it is a reasonable approximation." Furthermore, for the multi-dimensionality of instruments, they use a taxonomy by De Serres et al. (2010).

As can be seen in Figure 4, the EPS index is the result of a process of scoring and aggregating a sample of different instruments used across countries, mainly focusing on instruments regarding climate and air pollution. As the figure also shows, the index is weighted equally between market-based and non-market policies. Similarly, the market-based policies are weighted equally between taxes, trading schemes, feed-in-tariffs (FITs), and deposit and refund schemes (DRS). The non-market policies include standards and R&D subsidies, which are equally weighted. After these instruments are scored on a scale between 0-6, the scores are then aggregated in relation to their weights which then makes up the composite indicator of EPS which is also scored on a 0-6 scale.

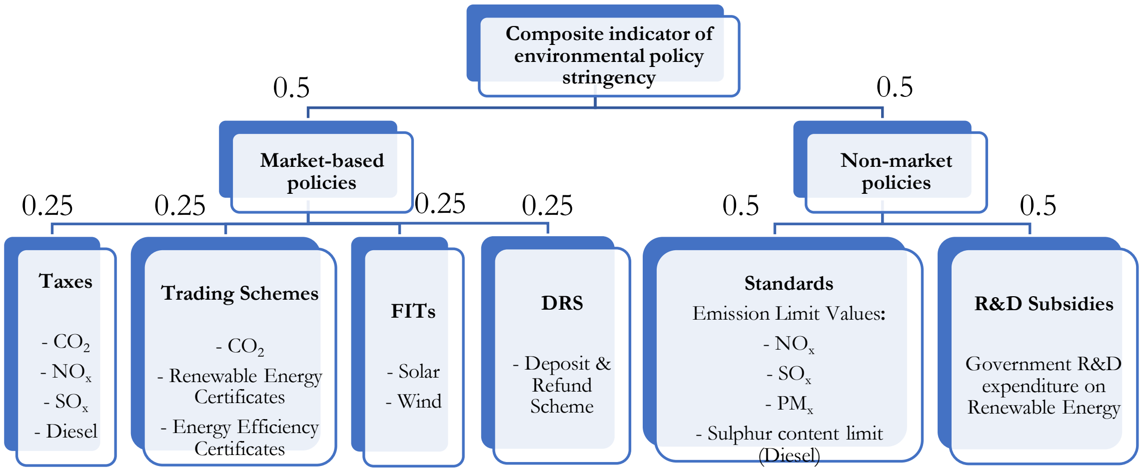

Figure 4: Environmental Policy Stringency Index – Components and weights

Source: Based on Botta and Koźluk, 2014.

Finally, as far as we know, we are the only paper using the EPS Index up to the year 2020. However, this also means that we are only able to use the aggregate EPS score for each country and year since the data set between 2012 and 2020 still needs to be updated on the subcomponents of the index (this data was later published a week before this paper's submission deadline).

4. Empirical Strategy and Results

In this section, we examine whether domestic EPS has a positive or negative impact on domestic net imports in polluting industries following our specification outlined in Section 3 and Equation (1).

4.1 OLS Baseline Estimates

Here, we outline the impact of EPS on net imports of dirty industries with controls and fixed effects for countries and years. This is shown in the Regression Table 1 below, where the estimates are also reported with clustered standard errors on the country and year level. The first observation is that the EPS estimate is insignificant in any of the Columns and that adding controls, as shown in Columns 2 through 6, does not significantly affect this estimate. Further, the estimates suggest that the EPS variable does not capture variation from the other determinants of dirty net imports. The interpretation of the EPS estimate in Column 6 – were it statistically significant – would be that a one-point increase in the EPS value of a country increases net imports from dirty industries by 0.003 percentage points. The only significant predictor of the net imports of dirty goods of a country is labour share and oil abundance, which are both significant at the 1% significance level indicating their relevant importance in determining the net import of a country's dirty industries.

While statistically insignificant, we see an interesting finding when we include a time lag effect of the EPS index on the net imports variable by shifting the latter 3 years ahead as motivated by the research of Kim & Lin (2022). This finding is that the weak (insignificant) support for the competitiveness hypothesis we provided above seems to become even weaker as time progresses, with the estimate dropping to 0.001 percentage points. This is possibly due to the mechanism described by the Porter Hypothesis, where the increased environmental costs induce innovation, thereby increasing domestic competitiveness. However, we must take these inferences with a grain of salt because of the low statistical power of our findings.

To gauge the economic significance of these results, we provide a quick comparison between Sweden and Turkey which differ on the EPS scale by ~1 point: 3.83 and 2.89 in 2020, respectively. While these countries are similar regarding non-market-based policies like emission limits, Sweden has established many market-based policies such as CO_2 trading schemes and carbon taxes which Turkey does not have. While a one-point difference may have heterogenous effects depending on the existing EPS value (and other determinants of dirty trade), this example puts into perspective that such a large change in environmental policies (through the introduction of a carbon tax and participation in the CO_2 trading scheme) would have such a small impact on the net imports from dirty industries.

Regression Table 1 - Baseline OLS regression table

	Dependent variable:						
	Dirty_Net_Imp						Lag_Net_Imp
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
EPS	0.004	0.003	0.003	0.004	0.004	0.003	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Labour_Share		0.269^{***}	0.271^{***}	0.250^{***}	0.247^{***}	0.249^{***}	-0.003
		(0.102)	(0.102)	(0.092)	(0.092)	(0.091)	(0.088)
Tariff			0.030	0.041	0.041	-0.006	0.019
			(0.045)	(0.050)	(0.050)	(0.055)	(0.081)
GDP_Capita				-0.003	-0.003	-0.004	-0.016^{**}
				(0.007)	(0.007)	(0.007)	(0.007)
FDI					-0.006	-0.0002	-0.035
					(0.007)	(0.010)	(0.029)
Oil						-0.003^{***}	-0.002^{***}
						(0.001)	(0.001)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	884	884	884	884	884	884	752
R^2	0.005	0.077	0.078	0.080	0.080	0.147	0.125
Adjusted R^2	-0.072	0.005	0.004	0.005	0.005	0.076	0.043
F Statistic	3.760^{*} (df = 1; 820)	34.255^{***} (df = 2; 819)	22.983^{***} (df = 3; 818)	17.707^{***} (df = 4; 817)	14.227^{***} (df = 5; 816)	23.485^{***} (df = 6; 815)	16.316^{***} (df = 6; 687)
Note:							*p<0.1; **p<0.05; ***p<0.01

4.2 Instrumentation Strategy

In the previous section, the OLS estimates suggested that the relationship between EPS and Net Imports from dirty industries is a statistically weak one, preventing us from rejecting the null. However, we cannot interpret these estimates causally due to issues of reverse causality and simultaneity bias. For example, as Ederington and Minier (2003) point out, political economy factors, such as the lobbying power of specific industries, may result in a distortion in the degree of environmental regulation of that specific industries. In this case, a positive bias would be introduced as the net imports then determine the EPS. Another source of potential bias is our proxy for environmental regulation, the EPS Index. Since this index does not encompass all instruments used by governments, a measurement error could arise, leading to a negative bias.

Considering these biases, we implement an IV strategy, where we find a source of variation in environmental regulation stringency that is not determined by net imports in dirty industries and does not affect it through any other channel. As described in Section 3.1, we employ the ventilation coefficient, which measures the speed at which pollutants disperse to instrument for environmental regulation stringency. The VC data is collated for the capital city, which as per previous literature, is a good proxy for the country. The motivation being countries with a higher ventilation coefficient face lower pollution concentration and thereby tend to act less stringent on regulations. The two requisites for a good instrument are exogeneity and relevance; we discuss these two in detail ahead while providing the first stage specification below:

$$EPS_{it} = \beta_1 * VC_{it} + \beta_2 * \tau_{it} + \beta_3 * F_{it} + \beta_4 * GDP_{it} + \beta_5 * FDI_{it} + \beta_6 * Oil_{it} + \mu_i + \mu_t + \varepsilon_{it} \text{ --(2)}$$

Congruous with the mechanism posed in the previous section, we find that the VC is a strong predictor of the EPS Index, as presented in Table 2 below. It has a statistically significant estimate with a p-value below 0.01 and indicates that a 1% increase in the VC of a country would predict a ~0.22 lower EPS index value. This is consistent with other literature which utilises a similar approach (Broner et al. 2012). Furthermore, the F-Statistic for this first stage regressions is 11.73 and is also significant at the 1% level allowing us to reject the weak instruments' null. We have also created a scatterplot of the average EPS index against the average VC of the country, which can be found in Figure 5, illustrating this relationship visually and providing proof of the relevance of this instrument in our model.

We contend that since the ventilation coefficient is determined by exogenous geographical and meteorological characteristics and determinants of pollutant dispersion, it should arguably satisfy the exogeneity rule for an instrument. However, we cannot discount the other channels through which the VC could impact Net Imports. To evaluate the validity of these other mechanisms, we also run some robustness checks (provided in the appendix as Regression Table 3), which are analysed next.

The ventilation coefficient does not seem to be correlated with the other determinants of net imports, such as labour share or oil abundance, with p-values greater than 0.4. Similarly, there is no significant correlation with GDP/Capita (or the wealth of a country), FDI or tariff rates while still being statistically significant for the EPS Index. This provides support for the exogeneity restriction, as the only mechanism through which the VC affects net imports should be through regulation stringency and not other channels such as labour abundance or oil abundance. However, there could be some other mechanisms not covered in our analysis which may have trickle-down effects on the net imports of dirty industries. This could be through as an example: affecting factors of production of the good encompassing the dirty industry categories outlined in our appendix.

Lastly, our IV estimate, while statistically insignificant, is ~70% higher than the baseline estimates for the OLS regression, implying a downward bias on the OLS possibly due to, e.g., measurement error.

4.2.1 2SLS Estimates

In this section, we will first estimate the 1st stage regression of the instrumental variable estimation, that is, to measure the impact of the Ventilation Coefficient on the Environmental Policy Stringency Index. We do this by sequentially adding the different controls to the equation to evaluate the robustness and sensitivity of the instrument while controlling for country and year fixed effects and clustering on that same level. As seen in Regression Table 2, the coefficient on the Ventilation Coefficient variable (VC) is negative and statistically significant at the 1% level in all the models, and it is unaffected by the addition of controls. The coefficient in Column 6 implies that a 1% increase in the Ventilation Coefficient leads to a 0.022 decrease in the EPS index of a country. These results are consistent with other literature which utilises a similar approach (Broner et al. 2012). The F Statistic for the first stage regression is 11.73 and is significant at the 1% level, indicating that our instrument passes the rule of 10 (Stock and Yogo, 2002), rejecting the null of the weak instruments test – however, we contend that this is just a rule of thumb and not a universal rule.

Regression Table 2 – First stage of the IV regression

	Dependent variable:					
	EPS					
	(1)	(2)	(3)	(4)	(5)	(6)
VC	-2.031***	-2.051***	-2.109***	-2.175***	-2.169***	-2.156***
	(0.624)	(0.630)	(0.630)	(0.641)	(0.641)	(0.640)
Labour_Share		0.709	0.892	2.239	2.216	2.218
		(1.521)	(1.536)	(1.759)	(1.788)	(1.792)
Tariff			2.868***	2.080**	2.085**	1.992**
			(1.081)	(1.045)	(1.047)	(0.987)
GDP_Capita				0.194**	0.193**	0.191**
				(0.092)	(0.092)	(0.091)
FDI					-0.049	-0.037
					(0.120)	(0.124)
Oil						-0.005
						(0.009)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
F Statistic	9.911**	10.084**	10.953***	11.998***	11.912***	11.733***
Observations	884	884	884	884	884	884
Note:						*p<0.1; **p<0.05; ***p<0.01

The two-stage least squares estimate of Equation (1) can be seen in Regression Table 4. It includes the instrumented EPS variable, country and year fixed effects and clustered standard errors on the same level. Taken at face value, the coefficient for the instrumented EPS in Column 6 indicates that a 1-point increase on the EPS scale will lead to an increase in Net imports from dirty industries by 0.003 percentage points. Theoretically, this would imply a leftward shift in the supply curve, as seen in Figure 1, as domestic companies would face higher costs due to increased regulations, thereby lowering domestic competitiveness and increasing import penetration. However, we note that this is statistically insignificant even at the 10% level, so we also analyse the 95% confidence interval computed in R to get a better understanding of the estimate. By doing so, we learn that a one-point increase in the EPS index could lead to a shift in net imports between the range (-0.026, 0.032) percentage points. While this does not provide indicative results of support for either the Porter or Competitive hypothesis, using the previous Sweden and Turkey example and the additional information that, on average, the countries in our dataset change their EPS value by ~0.15 on a year-on-year basis we can claim that the impact of EPS on net imports (despite being negative or positive) will be small in the range of -0.026 to 0.032 percentage points at a 95% confidence level.

Furthermore, looking at the other controls in this column we see that labour share and oil abundance are the only statistically significant variables in our regression and most of the other variables, while insignificant, still have a higher estimate than the instrumented EPS. This finding is important because it provides some suggestive evidence that the EPS may not be as comparable to other determinants of net imports such as human capital or resource abundance.

In column 6, we incorporate a time lag of the effect of regulations on trade flows by shifting all the net import values ahead by three years, as motivated by the research of Kim & Lin (2022). The interesting finding here (despite the statistically insignificant coefficient) is a negative relationship such that a 1-point increase in EPS will lead to a decline of 0.033 percentage points in dirty net imports after 3 years, providing some suggestive support for the opposing Porter Hypothesis in the "long run". According to this theory, the increased regulations pose compliance costs which induce innovation to circumvent those costs. This could then lead to increased domestic competitiveness and leads to a fall in net imports. Extending the analysis using an interval for this estimate, we compute that the true magnitude of this effect lies in the range (-0.0861, 0.0209) percentage points for a one-point increase in EPS at a 95% confidence level. While the upper bound can be interpreted as small, the ~3x lower bound is suggestive of a negative relationship which may be of much economic/policy importance. This could provide support for the rationale that, in the "long run", policymakers do not face a trade-off between increasing environmental regulation and domestic competitiveness.

An additional point to note about the time lagged columns in the OLS and IV regressions is that there is some attrition because of the shifting of the dependant variable (net imports) 3 years forward.

Because of the insignificance (even at a 10% level) of the point estimates for the instrumented EPS in the above analysis, we cannot reject the null nor assert any inferences for the population model. This indicates that either the true relationship is that there is no significant effect of environmental policies on net imports or that our model does not have sufficient statistical power to reject it, even though the null does not hold in the population model. This is also indicated by the Wu-Hausman test for the model outlined in Column 6, which gives a value of 0.039 and thus, we cannot say that the IV estimator is more consistent than the OLS estimate in our model. This could be because of a few reasons discussed more in-depth in Section 5.

Regression Table 4 – 2SLS Estimation Results

	Dependent variable:						
	Dirty_Net_Imp						Lag_Net_Imp
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
EPS	0.004	0.007	0.008	0.007	0.007	0.003	-0.033
	(0.017)	(0.016)	(0.016)	(0.015)	(0.015)	(0.015)	(0.027)
Labour_Share		0.267***	0.268***	0.242***	0.240***	0.249***	0.130
		(0.057)	(0.057)	(0.060)	(0.059)	(0.057)	(0.122)
Tariff			0.017	0.034	0.035	-0.007	0.057
			(0.054)	(0.045)	(0.045)	(0.043)	(0.062)
GDP_Capita				-0.004	-0.004	-0.004	-0.009
				(0.004)	(0.004)	(0.004)	(0.008)
FDI					-0.006	-0.0002	-0.034**
					(0.014)	(0.015)	(0.016)
Oil						-0.003***	-0.002***
						(0.001)	(0.001)
Constant	0.019*	-0.149***	-0.151***	-0.129***	-0.127***	-0.067*	0.040
	(0.012)	(0.035)	(0.035)	(0.039)	(0.038)	(0.036)	(0.070)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	884	884	884	884	884	884	752
Residual Std. Error	0.024 (df = 820)	0.024 (df = 819)	0.024 (df = 818)	0.024 (df = 817)	0.024 (df = 816)	0.023 (df = 815)	0.026 (df = 687)
Note:							*p<0.1; **p<0.05; ***p<0.01

5. Discussion and Limitations

5.1 Weak Instrument Bias

One of the limitations alluded to in the description of the first stage instrumental variable regression was the F-statistic which was stated as 11.73 and just above the rule of thumb (Stock and Yogo, 2002). While statistically significant at the 1% level, this does not universally confirm the instrument's relevance. We are thus on the side of caution by discussing the potential mechanism for a weak instrumental bias further below, acknowledging that the estimates are sensitive to the choice of our instrument.

In an attempt to explain the discrepancy with regards to the high F-statistic in Broner et al.'s (2012) analysis of the VC as an instrument, we contend that there is potentially a larger source of variation in our use of the EPS index than in the Lead Regulations which they proxy as a measure of the stringency of environmental regulations. While we praise the EPS index for its various benefits, such as its multidimensionality, this might also lead to an increase in the amount of noise when we regress it on the VC because it includes market-based and non-market-based instruments of regulation. As a result, this may reduce the variation explained by the VC and lead to some level of weak instrument bias.

If the instrument is weak, this could lead to a downward bias on the IV estimator to the OLS estimator and indicate that we may underreport some of the effect of the EPS on Net Imports. This result would imply that our 95% confidence intervals would not contain the true value less than the confidence level set. (Stock and Watson, 2003) While we have argued and presented empirical tests for the relevance of the ventilation coefficient, we do yield some level of weak instrument bias in our model.

5.2 Aggregation Issues

In contrast to previous studies that investigated the CH on an industry level, our study is conducted at the country level, thereby capturing the aggregate effects of all included dirty industries for each country. This means that the heterogeneous effects of EPS on industry-level competitiveness may cancel out at the country level. Competitiveness effects may also depend on country characteristics such as the level of development and income, trade openness, industrial structure and environment, labour, and other endowments, making the comparison of results of studies across different countries and periods difficult. Thus, future studies should incorporate different levels of aggregation (such as on the firm or industry level) to allow for more nuanced and precise interpretations.

A secondary limitation in our model pertains to the empirical specification itself. While we have included relevant controls (motivated under Section 3) such as labour share, oil abundance etc., we may still fall prey to omitted variable bias. Part of this problem arises from the fact that we are (to the best of our knowledge) one of the first papers to attempt to estimate the relationship between environmental regulation stringency and net imports on a country level, and we hope that the highlighted potential challenges in this analysis provide a stepping-stone for future research.

5.3 Data Limitations

Although the proxy used for stringency in this paper, the EPS Index, has some clear advantages vis-à-vis other measures of EPS, e.g., regarding the multi-dimensionality and identification issues discussed in Section 3, this index is imperfect. For instance, it is constructed based on the assumption that the few sampled sectors can approximate the stringency for all sectors in the market. Just as the creators of the EPS Index admit (Koźluk and Zipperer, 2014), this approximation may not hold if certain sectors have a stronger lobbying power than comparable sectors in terms of environmental externalities. Moreover, the instruments included are only a small sample of all instruments used in the jurisdictions that the index cover.

Another limitation regarding using the EPS Index in this study is that we use the aggregated EPS Index measure for each country without looking at the different subcomponents of the index. Even though this choice was made because of the lack of data for the years 2012-2020 (this data was later published a week before this paper's submission deadline), differentiating between, e.g., market-based and non-market-based policies could allow for an identification of what type of regulations that affect the competitiveness of a country. Be that as it may, the EPS Index is arguably still the best cross-country measure of the stringency of environmental regulations to date.

6. Conclusion

Previous papers investigating the relationship between environmental regulation and trade flows have been limited to a firm or industry level, as well as mostly focused on the US. To fill this gap in the literature, this paper represents the first attempt to test the competitiveness hypothesis on a country level.

Coming back to our research question: "What is the effect of environmental policy stringency (EPS) on net imports of dirty industries?", the results presented in this paper do not provide any conclusive answers, and, as such, we cannot decisively say whether the competitiveness hypothesis holds or not. From a broader perspective, this also means that we cannot provide any suggestions regarding the extent to which the pollution haven hypothesis might hold.

All things considered, our results differ from previous research conducted at the industry and firm level, which finds support for the competitiveness hypothesis. Instead, we suggest that other determinants of net imports are much more important, such as labour share, tariff rates, and FDI.

Recognising the limitations of the present study, especially the aggregation issues, weak instrument bias and data limitations, we generate a couple of learnings that future research may hopefully be able to draw on:

(1) Adopting a country-level frame and adding both industry-level and firm-level analyses would provide more complementary and nuanced results.

(2) Utilising the EPS Index/Sub-Index and the Ventilation Coefficient as a basis for future macro-level studies will provide a good opportunity for cross-country comparisons.

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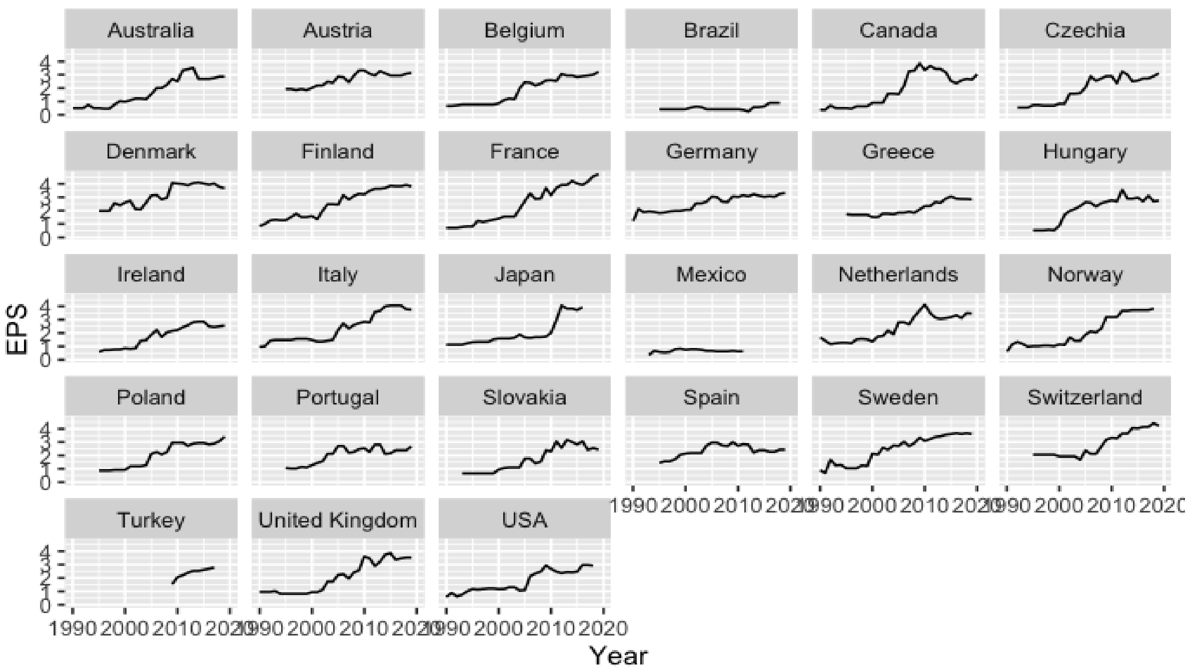
Appendix

Table 1: Summary Statistics

Variable Name	Mean	Standard Deviation	Minimum	Maximum	N
Environmental Policy Stringency Index	2.02	1.081	0.25	4.89	884
Total Net Imports (% of GDP)	-1.84%	0.0529	-28.76%	13.23%	884
Dirty Net Imports (% of GDP)	-0.74%	0.0561	-30.52%	13.94%	884
Share of Labour Compensation (%)	56.78%	0.0688	31.68%	72.25%	884
Average Weighted Tariff Rate (%)	3.69%	0.0311	0.71%	32.17%	884
GDP per Capita in USD ($'00 000)	2.907	1.5328	0.1255	9.3442	884
Net FDI Inflow (% of GDP)	3.87%	0.0913	-40.08%	109.33%	884
Ventilation Coefficient (log base 10)	3.51	0.3201	2.743	4.095	884
Oil per capita	17.418	9.120	1.239	40.261	884

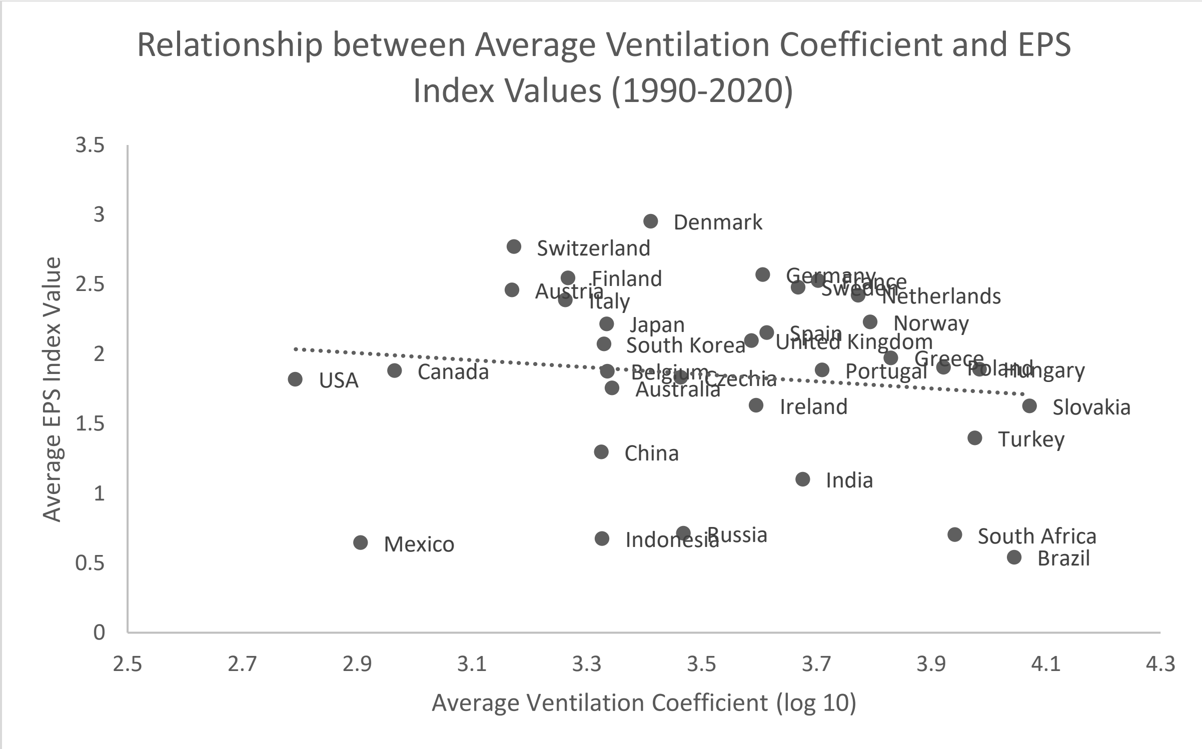
Sources include OECD, UN Comtrade, Federal Reserve Bank of St. Louis, Our World in Data, Worldbank Database, and ECMWF ERA-5 Database

Figure 1: Development of EPS over the past 30 years



Source: OECD Environmental Policy Stringency Index (2014)

Figure 5: Ventilation Coefficient and Environmental Regulation



Source: OECD Environmental Policy Stringency Index (2014) and monthly averaged Wind Speed + Boundary layer height data from the European Centre for Medium-Term Weather Forecasting ERA-5 Dataset

Regression Table 3 – Robustness test

	Dependent variable:						
	Labour_Share	Tariff	GDP_Capita	FDI	Oil	Dirty_Net_Imp	EPS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VC	0.028	0.019	0.220	0.116	2.625	-0.008	-2.031***
	(0.036)	(0.029)	(0.612)	(0.120)	(3.810)	(0.036)	(0.607)
Observations	884	884	884	884	884	884	884
R^2	0.001	0.001	0.0002	0.001	0.001	0.0001	0.013
Adjusted R^2	-0.076	-0.076	-0.077	-0.076	-0.076	-0.077	-0.062
F Statistic (df = 1; 820)	0.606	0.412	0.129	0.936	0.475	0.044	11.182***

Note: *p<0.1; **p<0.05; ***p<0.01

Table 2: Description of Pollution-intensive Products as Per SITC Revision-3 Selected for the Present Study

Industry	SITC Codes	Products Covered
Food and beverages	011, 012, 016, 017, 09811	Meat and meat preparations
	0986	Yeast
	022, 023, 024	Milk and milk products
	112	Alcoholic beverages
Pulp and paper	251, 641, 642	Pulp and paper
Non-metallic minerals	2732	Gypsum, limestone
	2782	Clays and refractory
	2784	Asbestos
	661, 662, 663	Lime, cement, construction materials
	664, 665	Glass and glassware
	666	Pottery
Iron and steel	671, 672, 673, 674, 675, 676, 677, 678, 679	Iron, steel and their products
Non-ferrous metals	682	Copper
	683	Nickel
	684	Aluminium
	685	Lead
	686	Zinc
	687	Tin
	689	Miscellaneous non-ferrous base metals
Chemicals	511, 512, 513, 514, 515, 516	Organic chemicals
	522, 523, 524, 525	Inorganic chemicals
	591, 592, 593, 597, 598	Other chemical products including insecticides, explosives and additives for mineral oils
	272, 562	Fertilisers
Petroleum and coal products	321, 322, 325	Coal, coke, semi-coke of coal
	333, 334, 335	Oils, residual petroleum products
	342, 343, 344, 345	Propane, butane, natural gas, other gases and hydrocarbons
Rubber	621, 625, 629	Materials and articles of rubber
Wood products	246, 633, 634, 635	Wood products, cork, veneer and plywood
Textile and leather	531, 532, 533	Colouring, dyeing and tanning materials, pigments and paints
	266, 6514, 6515, 6516, 6517, 6518, 6519, 653, 657	Fibres, synthetic filament yarn, fabrics and yarns

	611, 612, 613,	Leather and its manufactures
Manufactures of metals, nes (not elsewhere specified)	691, 692, 693, 694, 695, 696, 697, 699	Machine tools, cutlery, base metal equipment and structures of metals
Pharmaceuticals	541, 542	Pharmaceuticals
Machinery and electrical products	711, 712, 713, 714, 716, 718, 721, 722, 723, 724, 725, 726, 727, 728, 731, 733, 735, 737, 741, 742, 743, 744, 745, 746, 747, 748, 749, 751, 752, 759, 761, 762, 763, 764, 771, 772, 773, 774, 775, 776, 778	Boilers, turbines, engines, industrial, electrical and non-electrical machinery, tractors, pumps, mechanical equipment, accessories, etc.
Photographic films	882, 883	Films
Automobiles	781, 782, 783, 784, 785, 786	Vehicles and transport equipment
Mining and ore beneficiation	281, 282, 283, 284, 285, 286, 287, 288, 289	Ores and concentrates of iron and non-ferrous metals, wastes and scrap

Source: Based on Tantri and Bhat's (2022) compilation based on the SITC Codes and their descriptions.