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Research article

Soft and hard aspects of green behaviour: A firm-level study of the pollution haven hypothesis in the Mediterranean Basin



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ABSTRACT

The paper tests the pollution haven hypothesis in the context of three economies on the borders of the European Union in the Mediterranean Basin: Greece, Italy, and Turkey. Large differences in soft and hard aspects of green behaviour are revealed. Multinational firms are found to be more likely to use 'soft talk' strategies across the three economies. Yet the research also reveals that the multinationals are often more energy-intensive. Data for electricity consumption (where the largest regulatory differences exist across the EU border) show that there is a difference in the energy intensity of foreign and domestic firms in Turkey. At prices 45% lower than the unweighted EU average, the paper documents a 114% difference in electricity consumption by ownership. This difference in the difference between foreign and domestic firms' green behaviour across the three economies studied provides strong validation for the pollution haven hypothesis.

1. Introduction and background

The pollution haven hypothesis, which was introduced by Pethig (1976), suggests that differences in environmental legislation and regulation may be a distinct source of comparative advantage. Regulatory differences, including differences in taxation, can potentially drive the most polluting firms to relocate their production to pollution havens. The pollution haven hypothesis is thought to be sparked by significant policy changes, such as when the most highly developed countries start to introduce more stringent standards domestically (Triebswetter and Hitchens, 2005). One challenge to achieving a more sustainable and fair trading system in the context of the environment is, therefore, to ensure that the comparative advantages of countries are not based on regulatory differences because such advantages can be to the detriment of local populations, both in home and host countries (Costanza et al., 1995).

With the growing need to reduce global CO₂ emissions levels, it is becoming even more important to introduce and enforce regulatory alignment and transparency in the area of the green or polluting behaviour of firms. This is likely to elicit a mixed response (Van den Bergh, 2006; Banerjee et al., 2019; He et al., 2019; Peneder et al., 2017) because of firm heterogeneity. Large policy differences and protocols for regulatory alignment also remain across economic trading blocs and systems. The literature review will show that the evidence on the pollution haven hypothesis has been marginal in the ex-post (actual

conduct) relative to the ex-ante perspective (potential intent, see also Grossman and Krueger, 1991; Eskeland and Harrison, 2003; Javorcik and Wei, 2003). It is therefore essential to produce more evidence with firm-level data in order to better understand the behaviour of different firms, particularly in the context of specific regulatory environments.

The research question explored in this paper is whether Turkey is a pollution haven for foreign investors.

The econometric strategy is a difference-in-difference approach to the polluting and green behaviour of local and foreign firms operating in three geographically adjacent economies in the Mediterranean Basin: Greece, Italy, and Turkey. The econometric approach towards testing the pollution haven hypothesis is explained in detail in the section entitled econometric strategy.

The existence of a positive difference in the polluting behaviour of the two type of firms in the case of Turkey (outside the Internal Market regulations in the area of the environment) and relative to the same two type of firms in the control group (Greece and Italy, where firms operate under the EUs common acquis) would amount to strong evidence that Turkey is a pollution haven: in Turkey, firms have free trade access to exploit comparative advantages vis-a-vis the Internal Market, but their green behaviour is governed by Turkish environmental regulations (Boratav et al., 1996; EEA, 2019). Because of this border effect, Turkey is identified as a natural experiment for testing the pollution haven

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hypothesis (see also Akbostanci et al., 2008 and Candau and Dienesch, 2017).

Section 2 of the paper comprises a selective literature review focusing on the parts of the empirical literature that are relevant for comparison from the perspective of the present study. After the literature review, the methodology is presented in Section 3. It explains the data and econometric strategy adopted in the study. Section 4 reports results for the factor analysis aimed at identifying latent constructs of green behaviour. Then follows the main results, divided in two subsections (using factor regression scores as dependent variables vs. ordinary dependent variables). Prior to the conclusion, a discussion section of the paper holds the main results of the study up against the existing literature on pollution havens. The discussion section also explains the research and policy implications of the study.

2. Literature review

The literature review takes outset in previous literature reviews and some of the central problems plaguing the empirical literature on testing the pollution haven hypothesis. This is done with the aim of organising a brief and synthetic overview that helps to place the findings in this paper in perspective. In particular, the focus was on a recent and highly systematic literature review by Dechezleprêtre and Sato (2017) (offering an update since Jaffe et al. (1995) for other similar recent reviews; see also for example Cole and Elliott, 2005 and Cole et al., 2017). All previous literature reviews tend to conclude that the evidence on the pollution haven hypothesis is limited or, at best, mixed—showing when the effect exists, it is, in general, small and tends to be isolated to a particular subset of sectors and industries. The short review presented here outlines the main problems of the empirical literature to be as follows: aggregation level of previous studies (industry-level vs. firm-level), ex-ante vs. ex-post aspects to behaviour (e.g. assumed intent vs. conduct), and last, but not least, the type of pollution-related indicators used by researchers (assumed and only indirectly related or directly related to polluting activities). In particular, the last issue critically requires stronger and more valid evidence, and only 4–7 studies were found in the literature that could be argued to have come close towards overcoming this major hurdle of investigation (with firm-level indicators - Eskeland and Harrison, 2003, Javorcik and Wei, 2003, Jiang et al., 2014, Huang and Chang, 2019 and with territorial aggregates Greaney et al. (2017), Shi and Xu (2018) and Jensen and Mina (2019)). For example, out of the 13 firm-level studies on the impacts of inward or outward foreign direct investment (FDI) location decisions related to green behaviour reviewed by Dechezleprêtre and Sato (2017), only one of the reported studies (Eskeland and Harrison, 2003) included measures that directly equate with negative externalities such as energy intensity, pollution cost, or emissions of pollutants.

Therefore, the validity of a study must be of central concern when reading and evaluating past findings. Several studies suggest the literature suffers from omitted variables bias (see Levinson and Taylor, 2008; Ederington et al., 2005; Wagner and Timmins, 2009). This problem motivates the fixed effect panel data model in Levinson and Taylor (2008) now demonstrating a 10% elasticity between regulatory cost and trade volume. Similarly, recent studies have tackled problems of endogeneity. For example, Kellenberg (2009) demonstrates a relatively strong impact of environmental policy on outward FDI from the US over the period 1999–2003: e.g., around 9% of US value added abroad in foreign affiliates may be ascribed to the locational attribute of escaping more stringent environmental regulation at home. For an early similar study in the context of Europe, see also Jug and Mirza (2005) and the economic-geography-based study of Kheder and Zugravu (2012) for French multinationals, the UK-focused study by Manderson and Kneller (2012), or Chung (2014) for Korea: all of these studies methodologically bear some resemblance with Kellenberg (2009) in using uniquely constructed environmental regulation indices and connecting them to their impact on outward FDI location decisions (with firm-level data). These

authors all document a significant impact of regulatory differences on location decisions. The weakness of this part of the literature is the inability of researchers to document subsequent conduct in the subpopulation of host country firms, because potential motive does not equate neither intent nor conduct.

In a European context, authors have been able to solve some, but not all, of the three fundamental validity problems at the same time. For example, in Zugravu-Soilita (2017), although the indicators are de facto pollutants, the study relies on aggregates of FDI by home countries. In Kheder and Zugravu (2012), the focus is at the firm-level and location decisions among French subsidiaries or multinational plants; however, the indicator of regulatory differences is captured with a country-level indicator. Similarly, Manderson and Kneller (2012) promote the firm heterogeneity argument, but without focusing on the actual conduct of the foreign investors after they arrive in the host country. There is a surprising lack of studies on the pollution haven from a common EU perspective or from the perspective of the common acquis in the area of the environment and how it affects countries inside and outside the European Union and especially on its borders.

Not surprisingly, the literature has tended to gravitate towards China in recent years. For example, Jiang et al. (2014) is one of the most robust studies that meets all of the necessary requirements to fully report comparative results on the pollution haven hypothesis in the context of a rapidly industrialising host country such as China. The authors document that pollution levels in state-owned enterprises in China exceed those of their private domestic and foreign-owned counterparts. They also report that larger firms and firms with exporter status are less likely to pollute. The foreign ownership effect is negative and significant for most of the specifications in Jiang et al. (2014). As in Huang and Chang (2019) (see further below), Jiang et al. (2014) rely on data from a firm-level survey administered by the Ministry of Environmental Protection in China that was conducted once in 2004.

Shi and Xu (2018) showed for firms located in China across provinces and national levels of environmental regulatory stringency that stricter regulations led to a decline in the propensities of Chinese firms attaining exporter status. Through a back route, this study clearly demonstrated the pollution haven hypothesis because foreign-owned firms react in the host economy to stricter local regulatory measures by reducing export back to the home country. Closely related to the study by Shi and Xu (2018) and also for the Chinese context, Greaney et al. (2017) asks how China can continue its export- and FDI-led growth model whilst combating increasing problems of pollutants. The authors show the significant discriminatory cost on small and domestic firms of improving the regulatory environment in host countries such as China. Similar problems and results have been documented investigating the pollution haven hypothesis in the inter-regional perspective for China (see e.g. Yang et al., 2018; He et al., 2019; Shen et al., 2019; Wang et al., 2019). For the most valid studies in China, the effect of foreign ownership has been found to be consistently negative (e.g. any pollution haven effect is counteracted by the cleaner technologies adopted by foreign investors). This can be explained in part because the comparative ownership class is often state-owned enterprises in the Chinese context where there is an inheritance of an older capital apparatus and therefore also dirtier technologies. This is also, in part, because foreign firms are found to transfer, on average, cleaner technologies to China relative to what the private sector has adopted in this country. Very similar results were also found in Jensen and Mina (2019) in the context of Poland. Here similar pre-conditions exist in terms of inherited firms and technologies owing to the previous economic system. Conclusively, we cannot definitively state that there will always be a net negative effect on local populations from pollution haven type of attractors. The answer depends on the comparatives of individual contexts such as the propensities of local firm populations to pollute (before the foreign firms arrive), including specific specialisation patterns or other comparative advantages of the individual host country.

To conclude this brief review, there has been shown to be a combined improvement in validity and evidence in support of the pollution haven hypothesis and over time. These changes are not driven by progress in social science research methods alone, but by an escalation of a problem that used to concern only the production backyards of the EU and the US, to now include China both on an inter-regional and on a global scale of trade flows and integrated value chains (UNCTAD, 2018).

3. Methodology

A methodological challenge when studying the pollution haven hypothesis is that firms may not voluntarily participate in investigations of their green behaviour. When firms do participate, they may give untrue or biased information. Recent data collected with the green module under the World Bank's Enterprise Surveys (see also WB, 2019) gives researchers a unique opportunity to test the pollution haven hypothesis in a broader data collection context.

The objective of this paper is therefore also in part to improve validity in empirical studies of the pollution haven hypothesis. This is done by 1) using data at the proper level of polluting observational units (firms); by 2) combining soft and hard measures of green behaviour; and, finally, 3) by creating latent constructs that also aid in improving the reliability of dependent variables in studies of firm behaviour. However, for the latter, there are trade-offs between using latent constructs (harvesting more observations and data reduction) and the original dependent variables (preciseness in measurement and interpretation of results). For this reason, the study relies on both types of dependent variables, although its conclusions are based more strongly on one dependent variable in particular: electricity consumption quoted in Euros.

The methodology involves comparative cases both at the level of countries and firms. Under the econometric approach this is explained in detail.

3.1. Data

The variables used in the study were taken from the World Bank's most recent (2018/1029) Enterprise Surveys for Italy, Greece, and Turkey (for an introduction to the data sets see also WB, 2019), and include the following variables:

3.1.1. Ordinary dependent variables

- * Green Strategy - The firm's strategic objectives mention environmental or climate change issues. (A single dummy variable.)
- * Own Renewable Source - Does the firm use energy from its own renewable sources? (A single dummy variable.)
- * Electricity Consumption - Electricity consumption in Euro
- * Fuel Consumption - Fuel consumption in Euro
- * Solid Waste Production in kg

The descriptive statistics for the ordinary dependent variables are reported in Appendix 1, Table A1.1a by country and ownership.

3.1.2. Latent constructs/factor regression scores as dependent variables

- * Factor 1 - Soft talk
- * Factor 2 - Energy use

The average factor regression scores adopted as dependent variables in the analysis are reported in Appendix 1, Table A1.1b by country and ownership.

3.1.3. Main explanatory variables

- * FOR/JV/DOM/SOE - Ownership - where the Enterprise Surveys offer the possibility to distinguish, using dummies or percentages, the

distribution of ownership across domestic private, foreign, and state owners. (The dummy variable FOR is the main explanatory variable in the study. But control is also made for joint ventures across ownership classes with the dummy JV. Domestic owned firms (DOM) is the excluded dummy. For state owned enterprises (SOE) there are too few observations available to include this information in the study and these firms will therefore appear under the excluded dummy.

- * Exporter - Share of exports in total sales and/or whether the firm is export-active? (A single dummy variable taking the value of 1 when the firm is export active.)
- * Quality Certified - Does the firm have an internationally recognised quality certification? (A single dummy variable taking the value of 1 when the firm holds a quality certificate.)
- * Customers exert green standards - The firm's customers require certifications or adherence to some environmental standards? (A single dummy variable taking the value of 1 when the firm answers yes to this question.)

3.1.4. Other control variables

- * Age - The age of the firm in years since establishment.
- * Sales revenue - The size of the firm as estimated with its current sales quoted in Euros.
- * Region - Within country region (at Nuts level 1) of the establishment.
- * Industry - Four-digit ISIC code (Rev. 3.1).

Descriptive statistics for the explanatory and control variables are reported in Appendix 1 with Table A1.1c by country and ownership.

3.2. Econometric approach

The base specification estimated is as follows where Y is an ordinary dependent variable (or a latent construct L —instead estimated with the derived factor regression scores). Y is regressed on a constant that varies by country j and the main explanatory variable, which is the foreign ownership variable FOR . X is a vector of other important explanatory variables such as whether the firm is a joint venture, an exporter, and whether the firm has a general quality certification and/or is subject to specific green standards from its customers. C is a vector of control variables such as firm size, age, location within country, and industry classification. The standard errors reported throughout the paper are robust (White corrected) standard errors. The variables are indexed by firm i and country j . Some columns in the regression tables report specifications with sampling weights reflecting whether inference is at the population (firm count) level. Because of differential firm sizes, it is debatable whether or not weights should be applied (as discussed in the next subsection).

$$Y_{ij} = \alpha_j + \beta_j FOR_{ij} + \gamma_k X_{ij} + \delta_\theta C_{ij} + \varepsilon_{ij} \quad (1)$$

The econometric strategy follows the difference-in-difference estimator traditionally used when researchers have access to time-series data. Here, instead is used the spatial dimension as the revelatory factor for regulatory difference. Because the pollution haven hypothesis states that foreign firms will exploit these regulatory differences by outsourcing, for example, energy-intensive production to countries with less stringent regulations.

This is the kind of natural experiment (e.g. the border effect with Turkey) for which we could use the difference-in-difference estimator in accordance with Wooldridge (2009, Page 453–454). The transformation of the general table for deriving the difference-in-difference estimator is shown in Table 1 below. Before and after (e.g. the time difference) is substituted for the ownership difference, while the natural or usually policy experiment in this case is associated with national regulatory differences (shown in rows as the country difference, where Greece and Italy are considered control countries and Turkey is the treatment case

Table 1. Illustration of the difference-in-difference estimator in the context of this study.

	(Before) = DOM	(After) = FOR	After - Before = ΔFOR
Control 0 (omitted dummy for Greece)	α_0	$\alpha_0 + \beta_0$	β_0
Control 1 dummy for Italy	$\alpha_0 + \alpha_1$	$\alpha_0 + \beta_0 + \alpha_1 + \beta_1$	$\beta_0 + \beta_1$
Treatment 2 for Turkey	$\alpha_0 + \alpha_2$	$\alpha_0 + \beta_0 + \alpha_2 + \beta_2$	$\beta_0 + \beta_2$
Treatment 2 - Control 0	α_2	$\alpha_2 + \beta_2$	β_2
Treatment 2 - Control 1	$\alpha_2 - \alpha_1$	$\alpha_2 + \beta_2 - \alpha_1 - \beta_1$	$\beta_2 - \beta_1$

Source: Own adaptation inspired by Wooldridge (2009). *Introductory Econometrics - A Modern Approach*. South-Western, Cengage Learning. 4th Edition. Page 454.

because it applies lower environmental standards when regulating its businesses). The resulting two end corners in Table 1 that have been highlighted in bold are the difference-in-difference estimators for the pollution haven hypothesis, where a fulfilment of the hypothesis would require that $\beta_2 > 0$ (for the comparison Turkey-Greece) and/or that $(\beta_2 - \beta_1) > 0$ (for the comparison Turkey-Italy).

3.3. Sampling weights

In most specifications, sampling weights are not adopted. The Enterprise Surveys are based on stratified sampling to reflect the relative economic importance in the economy of different firms and, in particular, large employers (see also WB, 2019). Because employment is so heavily skewed towards the larger firms (especially for the subpopulation of foreign firms), the use of population inference based on random sampling by firm counts would be problematic. This is what would be reflected in the results if the sampling weights were adopted. Some tables do report benchmark results using the World Bank's sampling weights (and corrected by multiplying the original weights with the relative propensities of individual country samples in the total pooled sample). However, typically, the weighted results yield non-significance of effects by ownership (foreign): this is because the population or simple count weight of a foreign firm is often infinitely lower than its actual economic (and environmental) weight. Therefore, it is considered that in order to estimate the economic (and environmental) significance of foreign firms in the host economy, it is most appropriate to use probabilities that reflect stratification schemes based on the economic weight of each firm rather than the population or simple firm count weight. Firm heterogeneity therefore speaks against the idea of transferring the concept of population weights from individual-based to firm-based types of survey data.

4. Results

The results section first briefly reports the specific results derived using factor analysis with the aim of generating latent constructs of behaviour as dependent variables. The two main results sections follow. The first main section discusses the results of the analysis using factor regression scores as dependent variables. The second main section discusses similar results obtained when using specific dependent variables measured with the Enterprise Surveys. Full regression tables for all the individual dependent variables in the study are presented in Appendix 3.

4.1. Confirmatory factor analysis—deriving latent constructs of green behaviour

A confirmatory factor analysis was conducted in order to construct factor scores investigating the assumption that, together, the variables collected with the World Bank's green module within the Enterprise Surveys may form latent constructs that would lead to the identification

of at least two factors: soft and hard aspects of firms' green behaviour. With soft aspects the emphasis is on the firms' communication about green behaviour; in contrast, for the hard aspects of behaviour (energy usage), the emphasis is on the firms' de facto environmental performance through measurement of energy consumption data.

The final survey variables that fed into the factor analysis were as follows: *Green strategy*, *Green management*, *Monitor Energy Consumption*, *Target Energy Consumption*, *Target CO2 Emissions*, *Own Renewable Source*, *Electricity Consumption*, *Fuel Consumption*. The variables were selected from the surveys in a trade-off between relevance to the analysis and similar availability across the three countries surveyed. For example, the green module part of the Enterprise Surveys include many other relevant items for energy consumption (such as electricity, natural gas, and coal quoted in energy units). However, the variables measuring (other aspects of) fossil fuel consumption were sparsely available owing to many missing observations on the hard behavioural aspects when the data was captured in the green module part of the survey; as a result, it was only possible to include the variables for electricity and fuel consumption.

The results of the factor analyses are reported in Appendix 2 for the factor loadings and the uniqueness of individual variables. Because these results are only secondary to the analysis, they are not included in the main part of the study. Two factors were identified: (1) Soft talk and (2) Energy use. All the variables of behaviour except those pertaining to energy usage loaded most strongly on the first factor, whereas the hard aspects of behaviour as expected loaded on a separate factor that is negatively correlated with the first. The factors used as dependent variables in the econometric analysis are the regression scores calculated using the reported factor loadings in Appendix 2. Hence, the first factor contains elements of all variables including those related to the firm's own standard setting culture, except those for energy consumption. In contrast, the second factor separates out almost completely from the first (except from some loading running from *Green Management* to Factor 2). Hence, it may be ascribed almost solely to de facto energy usage by firms.

4.2. Results with factor regression scores as dependent variables

The results of the econometric analysis using factor scores as dependent variables are reported here in Tables 2 and 3.

The first results (Table 2) focus on the soft aspects (Factor 1: Soft talk) of green behaviour. The model is constructed in the first four columns using very similar base specifications: in the first column, without additional dummy variables other than those of main interest (country, ownership). For Factor 1, Turkey has a significant negative deviation from the intercept (here, in the first column of Table 2, solely represented with the excluded dummy for Greece; the intercept for the other countries is to be interpreted as a deviation from the global intercept). This result demonstrates that firms in Turkey, on average, are less likely to use Soft talk. The foreign dummy is positive and significant for all foreign firms across the three economies; hence, the average tendency is the same for all foreign firms in the sample. It shows that multinationals are much more likely to engage in Soft talk type of green strategies. These overall results do not change as we add additional controls: regional dummies (Column 2 in Table 2) and industry dummies (Column 3 in Table 2). However, upon adopting the variable that measures whether firms are subjected to green standards exerted by their customers (Column 4 in Table 2), the effect for the foreign firms disappears. This result is interpreted to show that the main motivation of multinationals to use Soft talk strategies runs through the customers' requirements of having green standards. Also, adoption of this additional covariate into the analysis significantly adds to model fit (e.g. R2 increases with 10% between Columns 3 and 4 in Table 2). All the covariates adopted are relevant explanatory factors of Soft talk. More mature firms, those that are quality-certified, larger firms as measured on the basis of their revenues, and those with exporter status exhibit a higher propensity to engage in Soft talk. The last two columns show results when adopting the survey weights. Similar results are obtained, except for the main variable

Table 2. Difference-in-difference estimation results for Factor score 1.

	Dependent variable:					
	Factor 1: Soft talk					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant (Greece/+all)	-0.980*** (0.136)	-1.401*** (0.151)	-1.487*** (0.204)	-1.136*** (0.180)	-0.793* (0.466)	-0.737 (0.478)
Italy	-0.209*** (0.053)	0.294** (0.116)	0.336*** (0.115)	0.126 (0.101)	-0.024 (0.173)	-0.043 (0.163)
Turkey	-0.444*** (0.043)	-0.588*** (0.073)	-0.527*** (0.078)	-0.460*** (0.075)	-0.422** (0.167)	-0.438*** (0.157)
FOR*Italy	0.136 (0.250)	0.012 (0.236)	0.032 (0.229)	0.258 (0.209)	0.585 (0.410)	0.532 (0.423)
FOR*Turkey	-0.288 (0.214)	-0.213 (0.193)	-0.150 (0.190)	0.013 (0.168)	0.245 (0.515)	0.162 (0.537)
FOR (Greece/+all)	0.512*** (0.148)	0.479*** (0.149)	0.434*** (0.142)	0.098 (0.132)	-0.013 (0.315)	0.001 (0.340)
JV	-0.068 (0.151)	-0.108 (0.142)	-0.098 (0.139)	-0.116 (0.133)	0.055 (0.221)	0.142 (0.266)
log Age	0.061*** (0.021)	0.068*** (0.020)	0.074*** (0.020)	0.063*** (0.019)	0.045 (0.035)	0.046 (0.037)
Quality Certified	0.137*** (0.031)	0.093*** (0.028)	0.069** (0.030)	0.036 (0.028)	0.120** (0.058)	0.123* (0.063)
log Sales revenue	0.063*** (0.010)	0.093*** (0.010)	0.089*** (0.010)	0.063*** (0.009)	0.035* (0.018)	0.032* (0.019)
Exporter	0.308*** (0.044)	0.220*** (0.040)	0.230*** (0.041)	0.178*** (0.039)	0.349*** (0.077)	0.354*** (0.082)
Customers exert green standards				1.107*** (0.066)		
Standard Errors	White	White	White	White	White	White
Region dummies	No	Yes	Yes	Yes	Yes	Yes
Industry dummies	No	No	Yes	Yes	Yes	Yes
Weights	None	None	None	None	Median	Strict
Observations	3,143	3,143	3,143	3,078	3,143	3,143
R ²	0.185	0.342	0.392	0.498	0.371	0.359
Adjusted R ²	0.182	0.336	0.355	0.466	0.332	0.320

Note: *p, **p, ***p < 0.01.

of interest, e.g. foreignness. This is due to the large discrepancy that exists between the simple count weights and the economic and environmental weight of multinationals in their host economies; see also the methodology section.

Similar results are obtained for Factor 2, but with important differences. Overall model fit is somewhat reduced when moving from Factor 1 (Soft talk) to Factor 2 (Energy use). This may relate to the fact that the underlying correlations between the energy usage variables are lower than those among the other softer aspects of behaviour.

The main difference in results for the model regressing Factor 2 on the same explanatory factors is with respect to the main variable of interest: foreignness. This is also true for the perhaps most important explanatory variable of soft behaviour besides industry differences—customers exerting green standards. The latter—although its inclusion may be relevant—does not affect energy usage much. Hence, by setting standards, customers may impact on the soft aspects of behaviour, but less so when it comes to energy consumption. The most important results in Regression Table 3 are for the (global = Greece/+all) dummy for all foreign firms in the three countries. The difference-in-difference estimators are insignificant in Regression Table 3, showing that in the factor part of the analysis there is no difference in the polluting behaviour of foreign firms across Greece, Italy, and Turkey. Instead, the general finding for all three countries is a confirmation of the pollution haven hypothesis because after controlling for other relevant factors of energy usage, the rate of

usage or energy intensity is on average higher in foreign-owned entities. This result does demonstrate that foreign firms stand out from other firms in the three countries specifically in regard to the hard aspects of their polluting or green behaviour and, in a way, thereby they have a negative impact on levels of pollution in the three host countries. However, because of the nature of the analysis presented here—e.g. when factor scores are dependent variables—the interpretation of the coefficient estimate cannot be made more exact.

4.3. Results for ordinary dependent variables

The full results for the econometric analysis using the original or underlying dependent variables that are measured with the Enterprise Surveys are shown in Appendix 3. However, because of the high number of potential dependent variables in the study, only the summarising results are shown in this section. The preferred specification (Columns 4 throughout the tables) is therefore shown for each of the most important dependent variables in Regression Table 4. The full tables are available in Appendix 3.

Table 4 shows the summary of results for the following dependent variables (row 1 in Table 4): *Green Strategy*, *Own Renewable Source*, *Electricity Consumption*, *Fuel Consumption*, and *Solid Waste Production* (where Solid Waste was added as an additional dependent variable even though it was dropped from the factor analysis early because of a very

Table 3. Difference-in-difference estimation results for Factor score 2.

	Dependent variable:					
	Factor 2: Energy use					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant (Greece/+all)	-1.477*** (0.230)	-1.690*** (0.262)	-1.407*** (0.244)	-1.401*** (0.238)	-0.847*** (0.124)	-0.918*** (0.134)
Italy	0.086** (0.040)	0.100 (0.065)	0.118 (0.085)	0.113 (0.092)	0.046 (0.049)	0.054 (0.049)
Turkey	-0.058** (0.025)	0.009 (0.043)	0.001 (0.081)	-0.005 (0.089)	0.039 (0.056)	0.048 (0.057)
FOR*Italy	0.225 (0.763)	0.327 (0.774)	1.025 (0.818)	0.779 (0.576)	-0.015 (0.102)	0.005 (0.109)
FOR*Turkey	-0.289 (0.286)	-0.286 (0.279)	0.421 (0.392)	0.269 (0.279)	0.015 (0.049)	0.039 (0.062)
FOR (Greece/+all)	0.670** (0.331)	0.660** (0.328)	0.208 (0.137)	0.291** (0.143)	0.089* (0.051)	0.078 (0.065)
JV	-0.565 (0.424)	-0.547 (0.412)	-0.912* (0.470)	-0.804** (0.350)	-0.167** (0.083)	-0.202* (0.108)
log Age	0.023 (0.021)	0.017 (0.021)	0.005 (0.018)	-0.003 (0.017)	-0.006 (0.010)	-0.006 (0.011)
Quality Certified	0.046** (0.018)	0.052*** (0.017)	0.040** (0.018)	0.038** (0.019)	0.045*** (0.017)	0.050*** (0.019)
log Sales revenue	0.097*** (0.016)	0.103*** (0.017)	0.090*** (0.014)	0.091*** (0.014)	0.053*** (0.006)	0.057*** (0.007)
Exporter	-0.161** (0.067)	-0.137** (0.060)	-0.134*** (0.048)	-0.124*** (0.041)	-0.083*** (0.026)	-0.096*** (0.030)
Costumers exert green standards				-0.013 (0.032)		
Standard Errors	White	White	White	White	White	White
Region dummies	No	Yes	Yes	Yes	Yes	Yes
Industry dummies	No	No	Yes	Yes	Yes	Yes
Weights	None	None	None	None	Median	Strict
Observations	3,143	3,143	3,143	3,078	3,143	3,143
R ²	0.075	0.105	0.300	0.338	0.230	0.247
Adjusted R ²	0.072	0.097	0.257	0.296	0.183	0.201

Note: *p, **p, ***p < 0.01.

high uniqueness score). Model fit in these alternative models using the Enterprise Survey constructs directly was generally higher, although poorest for the *Solid Waste* variable where R² for the explanatory model dropped to 30%. The previous results using factor scores as dependent variables are strongly supported when also using some of the most important survey constructs or underlying survey variables in the econometric analysis. However, some important differences also emerge, especially for the underlying variables of the Factor construct *Energy use*. For example, foreign firms are again found to be more likely to have adopted a Green Strategy (high in equivalence to results for Factor 1). However, this effect disappears once we control for costumers exertion of green standards (the full results are presented in Table A3.1). Only foreign firms in Italy were found to be more likely to use their own renewable energy sources (recall that this variable loaded more strongly on Factor 1 or ‘Soft talk’ in the Factor analysis). With respect to *Solid Waste* (which could not be included in the Factor analysis because it was unique or not correlated with any of the three factors), the ownership and country dummies in combination contained no explanatory power, leading to a rejection of the pollution haven hypothesis for this variable. Instead, the country dummies are significantly different from one another, showing that firms in Greece produce a significantly higher amount of solid waste per firm relative to firms in the other two countries.

It is with respect to the two main variables of the hard aspects of green behaviour that the most important difference emerges when focusing on

results using individual survey items, because there is a large difference in the results for electricity and fuel consumption, respectively (Columns 3 and 4 in Table 4). The main study hypothesis — that the pollution haven hypothesis would be found to hold true specifically for Turkey—is now confirmed when the focus is on electricity consumption alone. Using the results reported in Table 4, we can also, with high precision, determine the order of the effect (where it is necessary to take the exponent to the regression coefficients for dummy variables and deduct 1 because the dependent variable is measured in logarithmic units, see also Giles (1982)). Hence, using these results, we can calculate that firms in Turkey on average spend 68% ($\exp(-1.13)-1$) less on their electricity bill compared with the Greek firms in the sample. However, the difference is only 29% ($\exp(-1.13-(-0.79))-1$) when compared with firms in Italy. The foreign firms in Turkey deviate significantly from the average of all Turkish firms, spending typically 114% ($\exp(+0.76)-1$) more on their electricity bill compared with the global peer average in Turkey (but only 52% ($\exp(-1.13-(-0.79)+0.76)-1$) more compared to the same average in Italy and 31% ($\exp(-1.13 + 0.76)-1$) less than in Greece). This result also shows that firms in Greece are more pollution-intensive overall (when measured on electricity consumption and solid waste, but not for fuels, as discussed next: in regard to this, Turkish firms are overall least efficient). This particular example of the fulfilment of the pollution haven hypothesis can be explained by the fact that Turkish firms have a relative incentive to substitute away from electricity because it is expensive for them, but less so for foreign firms because of the regulatory differences

Table 4. Difference-in-difference estimation results for the ordinary dependent variables.

	Dependent variable:				
	Green Strategy (Yes/No) (1)	Own renewable source (Yes/No) (2)	log Electricity in Euro (3)	log Fuels in Euro (4)	log Solid waste in Kg (5)
Constant (Greece/+all)	-0.30*** (0.08)	-0.14** (0.07)	1.92*** (0.41)	1.91** (0.83)	7.60*** (0.80)
Italy	0.03 (0.04)	0.03 (0.03)	-0.79*** (0.16)	0.03 (0.35)	-1.78*** (0.42)
Turkey	-0.13*** (0.03)	-0.09*** (0.03)	-1.13*** (0.18)	0.85*** (0.30)	-1.96*** (0.42)
FOR*Italy	0.09 (0.08)	0.23*** (0.06)	0.21 (0.33)	-1.54** (0.73)	0.91 (0.83)
FOR*Turkey	-0.01 (0.08)	0.04 (0.06)	0.76*** (0.27)	-1.43*** (0.50)	0.72 (0.89)
FOR (Greece/+all)	0.06 (0.06)	-0.10** (0.04)	0.22 (0.16)	0.69 (0.49)	-0.80 (0.72)
JV	-0.03 (0.05)	0.05 (0.04)	-0.32 (0.20)	1.02** (0.44)	0.48 (0.65)
log Age	0.03*** (0.01)	0.01** (0.01)	0.03 (0.04)	0.38*** (0.07)	0.06 (0.07)
Quality Certified	0.03** (0.01)	-0.01 (0.01)	0.54*** (0.06)	0.41*** (0.12)	0.29** (0.12)
log Sales revenue	0.02*** (0.004)	0.01*** (0.003)	0.57*** (0.02)	0.42*** (0.04)	0.13*** (0.04)
Exporter	0.06 (0.02)	0.06*** (0.01)	0.04 (0.07)	0.18 (0.13)	-0.09 (0.15)
Costumers exert green standards	0.42*** (0.03)	0.23*** (0.02)	-0.11 (0.09)	0.17 (0.18)	0.003 (0.19)
Observations	3,072	3,030	2,898	2,718	1,412
R ²	0.43	0.40	0.58	0.37	0.39
Adjusted R ²	0.39	0.37	0.55	0.33	0.30

Note: *p, **p, ***p < 0.01.

(e.g. relative lower taxation of electricity, which is still more expensive in most EU countries compared with that in Turkey). Therefore, they have incentive to transfer that part of their production to Turkey, which is electricity-intensive. The observed differences correspond to this logic, and hence support the pollution haven hypothesis in a difference-in-difference comparison.

However, the reverse is observed to hold for fuel consumption. Relative to the EU, firms in Turkey tend towards consumption of other more subsidised forms of energy such as fuels. Here, we therefore find the opposite pattern, with firms in Turkey spending on average 134% more on fuels compared with all the sampled firms. The least fuel-intensive firms overall are foreign firms in Italy. They spend 79% less on fuels than the average firm in the sample (where there is no difference between the domestic firms in Italy and all the sampled firms). This effect is also present for foreign firms in Turkey, but less so, wherein foreign firms in Turkey spend on average 76% less on fuels than their domestic peer average or 44% less than all the sampled firms. However, the regulatory differences for our comparative context (e.g. the Mediterranean Basin) are much smaller in this case, and here we do not see that the pollution haven hypothesis is relevant: in fact the opposite, because in regard to fuel consumption, it is found that foreign firms are generally more energy-efficient than their domestic counterparts (and although this is true both in Turkey and Italy, the same effect is not found for Greece). Therefore, without the regulatory difference that forms the basis of the pollution haven hypothesis, we should normally expect such a result because of the typically superior access of multinational firms to more modern and energy-efficient technologies. This is what some authors in the literature have concluded instead to be a 'pollution halo' effect (see

for example [Balsalobre-Lorente et al., 2019](#)), although in fact it is the 'normal' effect we should be observing without the regulatory difference.

Finally, it should be noted that the contrast in study findings observed between electricity and fuel consumption corresponds well with the regulatory differences that persist across the EU border. The differences in taxation of fuels (all three countries have a relatively low level of taxation of fossil fuels) are much lower relative to the differences in taxation of electricity when comparing the three countries. Turkey has a low level of taxation, whereas Greece and Italy both have a relatively high level of taxation (see [EC, 2019](#), [Eurostat, 2020](#)). The data on taxation therefore supports the relevance of the natural experiment in the context of the study, given that taxation is a reflection of societal norms in terms of regulating negative externalities such as those in the area of the environment. Similar ideas and results were also reported for the natural experiment or border effect that exists in the Mediterranean Basin for marine protected areas in [Claudet et al. \(2020\)](#).

5. Discussion

The pollution haven hypothesis is investigated in the paper in the context of three economies in the Mediterranean Basin, wherein one of them, namely Turkey, must be considered an appendant to the Internal Market in terms of firms' access to exploit their comparative advantages. However, Turkey is not regulated under the common *acquis* in the area of the environment: this is also reflected in the differences in taxation of negative externalities, as was discussed towards the end of the analysis. The literature review shows that there is a relative dearth of studies in the European context, in particular in the context of the EU member states and border effect with the other countries in the Mediterranean Basin.

The previous studies, in particular those conducted for Europe, are weaker because most of them fail to fulfil the three validity concerns identified in the literature: aggregation, potential motive vs. intent or conduct, and reliability of pollution indicators —if and when these studies have used such indicators at all.

In contrast, the recent firm-level studies identified in the context of the Chinese transition were found to be stronger in validity. The present study uses a similar methodology to several of the recent Chinese studies, with the additional advantage of operating with more than one indicator or dependent variable to capture green behaviour. An advantage of the present study from a methodology viewpoint is also that it is based on the random stratified sampling schemes developed under the Enterprise Survey methodology, whereby firms are captured (when observations are broadly available) according to their economic, and therefore also environmental, weight across the three economies. Furthermore, cross-country sample size differences for the Enterprise Surveys also reflect the relative economic weight of each country when pooling several country-level data sets. Hence, the study validly reports a confirmation of the pollution haven hypothesis with respect to the harder aspects of green behaviour and, here, specifically for foreign firms in Turkey. While firms in Turkey on average spend less on their electricity bill (and controlling for other relevant factors such as age of the firm, sales revenue, industry, and regional location) than firms in the two other comparator countries (Greece and Italy); foreign firms, on average, outspend firms in Turkey by 114%. Hence, it is safe to conclude that foreign firms in Turkey are generally more electricity-intensive than most of the other sampled firms (firms in Greece in general being the exception to this pattern, although no difference by ownership was found).

As a secondary research result, confirmatory factor analysis also shows that there is a large difference between soft and hard aspects of green behaviour in the Mediterranean Basin, especially for the foreign firms operating there. Although foreign firms exhibit superior performance in terms of their soft behaviour (communication about strategy and adoption of renewable technologies) or what is collectively represented by the latent construct of ‘soft talk’, the results for the harder aspects of green behaviour or de facto pollution outcomes reveal a large difference between soft talk measures and hard aspects of behaviour such as energy consumption. This means that when foreign firms signal in strategic and symbolic ways that they wish or strive to exhibit or exemplify green behaviour, it does not necessarily exempt them from fulfilling the pollution haven hypothesis. This finding underlines the importance of the validity of indicators used when investigating the research question. For example, we cannot rely only on what respondents think they do; we also need to apply hard measures that reveal their actual conduct when it comes to polluting practices.

The policy implications of the study follow from the above findings. Regulators cannot rely on firms governing themselves in the area of green behaviour if they hope to achieve measurable results for the environment. From the perspective of the EU-28 free trade agreements with Internal Market appendants such as Turkey and other Mediterranean Basin countries, including, in particular, border economies in North Africa, it is paramount to ensure additional regulatory measures to avoid fulfilment of the pollution haven hypothesis. This is because current practices reveal that the present regulatory environment or vacuum leads to a negative drift in the comparative advantages exploited by firms across countries in ways that are in direct opposition to what the EU seeks to achieve through other environmental measures (such as the Paris agreement). Therefore, the current regulatory environment is also in direct opposition to what is sought to be achieved with other policies such as regional, territorial, innovation, and technology policies. Preventing the fulfilment of the pollution haven hypothesis, especially in the case of vulnerable border countries outside the EU, cannot be over-emphasised; this would be to the benefit of local populations and firms both inside and outside the EU. While studies on electricity prices conducted by consultancies for the European Commission would indicate that such differentials are not in place, the present findings underscore

the importance of economic analysis in correctly reporting prices in a way that reflects the actual signals perceived and used by firms when making their investment decisions. For example, a study by [Trinomics \(2018\)](#) for the European Commission suggests that Turkey has higher energy prices than the EU-28 when using a weighted average. However, this study of green behaviour demonstrates that this may not be the correct indicator to look at in the variable geographies that exist within Europe. The correct basis for comparison continues to be the relative price level between home and host when foreign investors make their decisions.

6. Conclusion

Initial confirmatory factor analysis reveals a large fault line between soft and hard aspects of green behaviour in the Mediterranean Basin. This idea is further applied in the paper to investigate the main study hypothesis. Using both latent constructs and individual survey items from the Enterprise Surveys, the study confirms the pollution haven hypothesis in the specific context of the three economies (Greece, Italy, and Turkey) studied in the Mediterranean Basin. Although foreign firms exhibit superior performance in terms of soft behaviour (communicating about it including symbolic gestures such as investment in own renewables), the results for the harder aspects of green behaviour or de facto pollution outcomes reveal a large difference. Distilling green behaviour down to energy consumption, the study documents a significant impact of foreignness on energy consumption. Results are robust to controlling for factors such as green standards imposed on the firm, export status, and firm age and size. The effect is documented to be large and significant in the context of the non-regulated (from an extra-territorial perspective) Internal Market appendant of Turkey. While firms in Turkey spend between 68–29% less on their electricity bills than in the other two EU member states (Greece and Italy respectively), foreign firms in Turkey spend 114% more than similar domestic firms; or 52% more on average than other similar firms in Italy. In contrast, foreign firms in the three Mediterranean countries were found to be overall fuel intensive. However, for Turkey, there was found to be higher fuel efficiency in foreign firms relative to domestic firms. Complementary data on electricity prices before and after taxes ([Eurostat, 2020](#)) also reveals that while negative externalities pertaining to electricity consumption are also taxed in Turkey, this occurs at a rate that is 45% below the average (non-weighted) rate applied inside EU-28. It must therefore be concluded that regulatory differences persist across this border and may have a quite large impact on firms’ green behaviour in Europe.

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Author contribution statement

Camilla Jensen: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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References

- Akbostancı, E., İpek Tunc, G., Türüt-Aşık, S., 2008. Environmental impact of customs union agreement with EU on Turkey's trade in manufacturing industry. *Appl. Econ.* 40 (17), 2295–2304.
- EC, 2019. Energy Prices and Costs in Europe. Report Presented by the European Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Brussels.
- Balsalobre-Lorente, D., Gokmenoglu, K.K., Taspınar, N., Cantos-Cantos, J.M., 2019. An approach to the pollution haven and pollution halo hypotheses in MINT countries. *Environ. Sci. Pollut. Control Ser.* 26 (22), 23010–23026.
- Banerjee, R., Gupta, K., McIver, R., 2019. What matters most to firm-level environmentally sustainable practices: firm-specific or country-level factors? *J. Clean. Prod.* 218, 225–240.
- Boratav, K., Türel, O., Yeldan, E., 1996. Dilemmas of structural adjustment and environmental policies under instability: post-1980 Turkey. *World Dev.* 24 (2), 373–393.
- Candau, F., Dienesch, E., 2017. Pollution haven and corruption paradise. *J. Environ. Econ. Manag.* 85, 171–192.
- Chung, S., 2014. Environmental regulation and foreign direct investment: evidence from South Korea. *J. Dev. Econ.* 108, 222–236.
- Claudet, J., Loiseau, C., Sortes, M., Zupa, M., 2020. Unprotected marine protected areas in a global diversity hotspot. *One Earth* 2, 380–384.
- Cole, M.A., Elliott, R.J., 2005. FDI and the capital intensity of “dirty” sectors: a missing piece of the pollution haven puzzle. *Rev. Dev. Econ.* 9 (4), 530–548.
- Cole, M.A., Elliott, R.J., Zhang, L., 2017. Foreign direct investment and the environment. *Annu. Rev. Environ. Resour.* 42, 465–487.
- Costanza, R., Audley, J., Borden, R., Ekins, P., Folke, C., Funtowicz, S.O., Harris, J., 1995. Sustainable trade: a new paradigm for world welfare. *Environment* 37 (5), 16–44.
- Dechezleprêtre, A., Sato, M., 2017. The impacts of environmental regulations on competitiveness. *Rev. Environ. Econ. Pol.* 11 (2), 183–206.
- Ederington, J., Levinson, A., Minier, J., 2005. Footloose and pollution-free. *Rev. Econ. Stat.* 87 (1), 92–99.
- EEA, 2019. Drivers of Change of Relevance for Europe's Environment and Sustainability. European Environment Agency, EEA Report, No. 28/2019, Luxembourg.
- Eskeland, G.S., Harrison, A.E., 2003. Moving to greener pastures? Multinationals and the pollution haven hypothesis. *J. Dev. Econ.* 70 (1), 1–23.
- Eurostat, 2020. Electricity price Statistics. Online Publication. Last Updated May 2020. Eurostat, the European Union, Luxembourg.
- Giles, D.E., 1982. The interpretation of dummy variables in semilogarithmic equations: unbiased estimation. *Econ. Lett.* 10, 77–79.
- Greaney, T.M., Li, Y., Tu, D., 2017. Pollution control and foreign firms' exit behavior in China. *J. Asian Econ.* 48, 148–159.
- Grossman, G.M., Krueger, A.B., 1991. Environmental Impacts of a North American Free Trade Agreement (Working Paper No. W3914). National Bureau of Economic Research.
- He, L.Y., Lin, X., Liu, Q., 2019. How did free trade reshape the transitional China? Evidence from heterogeneous exporters and firm-level pollution emissions. *Emerg. Mark. Finance Trade* 56 (8), 1–26.
- Huang, C.H., Chang, H.F., 2019. Ownership and environmental pollution: firm-level evidence in China. *Asia Pac. Manag. Rev.* 24 (1), 37–43.
- Jaffe, A.B., Peterson, S.R., Portney, P.R., Stavins, R.N., 1995. Environmental regulation and the competitiveness of US manufacturing: what does the evidence tell us? *J. Econ. Lit.* 33 (1), 132–163.
- Javorcik, B.S., Wei, S.J., 2003. Pollution havens and foreign direct investment: dirty secret or popular myth? *B E J. Econ. Anal. Pol.* 3 (2).
- Jensen, C., Mina, A., 2019. Did transition bring cleaner air? Effects of ownership, territorial and technology policy on air pollution. *Ecol. Econ.* 165, 106276.
- Jiang, L., Lin, C., Lin, P., 2014. The determinants of pollution levels: firm-level evidence from Chinese manufacturing. *J. Comp. Econ.* 42 (1), 118–142.
- Jug, J., Mirza, D., 2005. Environmental regulations in gravity equations: evidence from Europe. *World Econ.* 28 (11), 1591–1615.
- Kellenberg, D.K., 2009. An empirical investigation of the pollution haven effect with strategic environment and trade policy. *J. Int. Econ.* 78 (2), 242–255.
- Kheder, S.B., Zugravu, N., 2012. Environmental regulation and French firms location abroad: an economic geography model in an international comparative study. *Ecol. Econ.* 77, 48–61.
- Levinson, A., Taylor, M.S., 2008. Unmasking the pollution haven effect. *Int. Econ. Rev.* 49 (1), 223–254.
- Manderson, E., Kneller, R., 2012. Environmental regulations, outward FDI and heterogeneous firms: are countries used as pollution havens? *Environ. Resour. Econ.* 51 (3), 317–352.
- Peneder, M., Arvanitis, S., Rammer, C., Stucki, T., Wörter, M., 2017. Competitiveness and Ecological Impacts of green Energy Technologies: Firm-Level Evidence for the DACH Region (Working Paper No. 544). WIFO Working Papers.
- Pethig, R., 1976. Pollution, welfare, and environmental policy in the theory of comparative advantage. *J. Environ. Econ. Manag.* 2 (3), 160–169.
- Shen, J., Wang, S., Liu, W., Chu, J., 2019. Does migration of pollution-intensive industries impact environmental efficiency? Evidence supporting “Pollution Haven Hypothesis”. *J. Environ. Manag.* 242, 142–152.
- Shi, X., Xu, Z., 2018. Environmental regulation and firm exports: evidence from the eleventh Five-Year Plan in China. *J. Environ. Econ. Manag.* 89, 187–200.
- Triebswetter, U., Hitchens, D., 2005. The impact of environmental regulation on competitiveness in the German manufacturing industry—a comparison with other countries of the European Union. *J. Clean. Prod.* 13 (7), 733–745.
- Trinomics, 2018. Study on Energy Prices, Costs and Subsidies and Their Impact on Industry and Households. A Study Conducted by Trinomics for the European Commission. DG Energy, Brussels.
- UNCTAD, 2018. Trade and Development Report 2018 - Power, Platforms and the Free Trade Delusion. United Nations Conference on Trade and Development, New York and Geneva.
- Van den Bergh, J.C., Faber, A., Idenburg, A.M., Oosterhuis, F.H., 2006. Survival of the greenest: evolutionary economics and policies for energy innovation. *Environ. Sci. J. Integr. Environ. Res.* 3 (1), 57–71.
- Wagner, U.J., Timmins, C.D., 2009. Agglomeration effects in foreign direct investment and the pollution haven hypothesis. *Environ. Resour. Econ.* 43 (2), 231–256.
- Wang, X., Zhang, C., Zhang, Z., 2019. Pollution haven or porter? The impact of environmental regulation on location choices of pollution-intensive firms in China. *J. Environ. Manag.* 248, 109248.
- WB, 2019. Italy 2019 Enterprise Survey Implementation Report. The Enterprise Surveys. The World Bank.
- Wooldridge, J.M., 2009. Introductory Econometrics: A Modern Approach, South Western. Cengage Learning.
- Yang, J., Guo, H., Liu, B., Shi, R., Zhang, B., Ye, W., 2018. Environmental regulation and the Pollution Haven Hypothesis: do environmental regulation measures matter? *J. Clean. Prod.* 202, 993–1000.
- Zugravu-Soilita, N., 2017. How does foreign direct investment affect pollution? Toward a better understanding of the direct and conditional effects. *Environ. Resour. Econ.* 66 (2), 293–338.