Environmental compliance costs in selected European countries: an alternative approach

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Abstract

Company faces different internal and external costs in carrying out their activities. Company's external costs include, inter alia, costs due to the existence of different regulations and related taxes. In the field of environmental protection, the company that cause environmental damage have certain costs, i.e. environmental compliance costs, associated with the existence or introduction of environmental legislation. These costs embrace activities such as time devoted to acquaintance with the requirements of the regulation, preparation and entry of information in the forms, costs of regulatory impact assessments, etc. From company's perspective, these costs are often excessive and suboptimal. Several methodological approaches can be found in the literature for measuring the costs of environmental regulation. Among the most commonly used are the Standard Cost Model (SCM) that is used world wide, business report data, surveys and interviews, among others. In addition to the existing ones, the costs of environmental regulation can be assessed in other ways. Literature reveals a reasonable assumption that environmental protection expenditure in the industrial sector are positively correlated with the actual companies' costs of compliance with environmental regulations. In this respect, they can be used as a proxy to properly assess the costs of private sectors, related to environmental regulation obligations. Time series of the estimated environmental protection expenditures in industrial sector in the period 2014–2018 demonstrate an average increase of 0.8 % per time point, with an observed slight increase on average (0.46 %) in the period 2017–2018. Empirical results demonstrate that in 2018 Austria, Belgium, the Czech Republic and Estonia have the highest estimated environmental protection expenditures in industrial sector, ranging from 2.8 % to 1.5 % of GDP. Among the countries with the lowest estimates are Greece, Ireland, Romania and Malta, ranging between 0.1% and 0.3 of GDP.

Keywords: environmental expenditures, industry sector, compliance costs, environmental regulation, public administration

1 Introduction

An important topic of the efficiency and effectiveness of the tax system is a debate on tax complexity and opportunities for tax simplification. In addition to tax liabilities, companies must fulfil obligations arising from the tax system. The costs imposed by taxation systems may be divided into three groups (Tran-Nam et al., 2000), namely: (i) taxes themselves, including taxes on employees, the products or on profits; (ii) efficiency costs that include tax-induced market distortions, e.g. excess burden or deadweight losses, and (iii) operating costs of the tax system that includes administrative costs, i.e. the costs to the government of administering and collecting taxes, and compliance costs, i.e. the costs incurred by taxpayers in complying with their tax obligations. The compliance costs are particularly interesting to research, as these costs represent the hidden costs that companies are often not fully aware of.

C.T. Sandford (Sandford, 1973; Sandford et al., 1989) was a pioneering researcher in the contemporary research in the taxation area of compliance costs of companies. Since then a vast number of literature has been undertaken in many (non-)OECD countries (Chittenden et al., 2003, 2005; Eichfelder & Vaillancourt, 2014; Hansford & Hasseldine, 2012; Hasseldine & Hansford, 2002; Office of Management and Budget, 2017; Slemrod & Blumenthal, 1996; Slemrod & Venkatesh, 2002; Smart Prosperity Institute, 2018), and this topic has been a much debated among government policy makers, academics and business organisations. In general, literature suggests that tax compliance costs, including environmental compliance costs, represent a considerable red tape burden for companies and households (Eichfelder & Hechtner, 2018). The need for tax compliance of taxpayers is reflected in the tax compliance burden that consequently reduces economic resources of companies without increasing fiscal inflows into the budget of the government (Djankov et al., 2002).

Previous research provides evidence that the compliance costs are large especially for SMEs in most OECD countries. Compliance costs are especially high in absolute terms and relative to the size of the companies, whether assessed by reference to turnover, number of employees, income, or other computational approximation (Al-Shammari et al., 2008; Dong, 2007; Lignier et al., 2014). Literature also states that compliance costs do not appear to be diminishing, but are actually increasing over time (Kayser et al., 2004; Kegels, 2014; Kotnik et al., 2020; OECD, 2001).

Environmental compliance costs normally present only a smaller parts of the total company’s costs, but they are not negligible (Gray & Shadbegian, 2003). Companies are also not required to report compliance costs in their annual reports, so researchers use very different ways to measure compliance costs. Several methodological approaches can be found in the literature for measuring the costs of environmental regulation (European Commission, 2012, 2013; HLG, 2014; Kayser et al., 2004; Kegels, 2014; Klun et al., 2011; OECD, 2001; Pope & Owen, 2009; Van den Abeele, 2010). Among the most commonly used are the world-wide used Standard Cost Model (SCM) (DEFRA, 2006; European Commission, 2012), business reports data (Crain & Crain, 2010; Crews, 2002), individual countries’ questionnaires (Kayser et al., 2004; Kegels, 2014; Kotnik et al., 2020) and structured interviews (Joshi et al., 2001). Where Standard Cost Model (SCM) the most commonly used methodologies for measuring compliance costs with environmental regulations.

However, the above-mentioned methodological tools for measuring environmental compliance costs also contain a number of methodological challenges and cost measuring issues. For example, size of the sample, different time intervals of data acquisition, different legislation framework of countries, (un)intended misstatements of survey respondents, misallocation of costs, misevaluation of the value of compliance time effort, diverse methodological approaches to measure these costs, among others (Eichfelder & Hechtner, 2018; Sandford et al., 1989; Tran-Nam et al., 2000). Estimates the costs of environmental regulations are often overestimated by at least double, and sometimes by a factor of 10 or more, however, in general it is argued that regulations can potentially be good for business, the government and the environment when the total benefits outweigh the total cost (Smart Prosperity Institute, 2018). In this article, we want to overcome the above-mentioned methodological and other challenges of measuring the costs of compliance with environmental regulations and focus on measuring these costs through by using an alternative approach for measuring the costs of compliance with environmental regulations. Literature (Le Roux et al., 2008) reveals a reasonable assumption that environmental protection expenditure in the industrial sector are positively correlated with the actual companies' costs of compliance with environmental regulations. In this respect, they can be used as a proxy to properly assess the costs of private sectors, related to environmental regulation obligations. This article is concerned with environmental compliance costs in industrial sector in selected European countries. The rest of the paper is divided as follows: firstly, the methodological section is presented, where research design, problem of missing data and applied imputation technique is presented. In the next section the results of estimated environmental protection expenditures for 32 European countries for the time series 2014–2018 are presented. The last section concludes with public policy recommendations.

2 Methodology

2.1 Research design

Literature review demonstrates several approaches to estimate environmental compliance costs. In this article we apply an alternative methodological approach, i.e. the scientific approach suggested by scholars (Le Roux et al., 2008) who propose that the costs of compliance with environmental regulations for companies are positively correlated to the actual costs of private-sector administration in relation to environmental regulatory obligations. Researchers (Le Roux et al., 2008) demonstrate a three-step methodology for the estimation of compliance costs with environmental regulations. The first step comprises the comparison of environmental protection expenditures in the industrial sector between 32 European countries. In the second step, the environmental regulatory regime index developed by Esty and Porter (Esty & Porter, 2001) is be applied in order to perform comparison between selected countries. In the third step, the comparison of the environmental quality of each country with other countries on the basis of three criteria: SO2, PM10 and energy efficiency (Kotnik et al., 2020) is made.

Within the empirical results section of this paper, the results of the first step methodology suggested by scholars (Le Roux et al., 2008) for the comparison of compliance costs with environmental regulations for businesses are being presented. The empirical results demonstrate the comparison of environmental protection expenditures in the industrial sector between 32 European countries. Data for environmental protection expenditures were collected from Eurostat databases (Eurostat, 2022) and were available for 32 European countries. Presented results demonstrate time series between years 2014 and 2018. The calculation for environmental protection expenditures in industry sector for 32 European countries is as follows, namely:

$$EEPE = eepa + tec + \mathrm{med}c + sec \qquad (1)$$

EEPE...estimated environmental protection expenditures in industry sector
eepa... expenditures in environmental protection activities
tec... technical costs
medc... medical costs

sec... security costs

Technical, medical and security costs are defined as follows (Eurostat, 2022), namely: technical costs, medical costs and security costs together represent all environmental related expenditures. Technical costs are environmental expenditures associated with technical measures taken in the production process, e.g. cleaning and repairing of engines. Technical measures consist of so-called 'process-integrated' and 'end-of-pipe' measures. An example of a process-integrated measure is the use of a lean burn engine in production processes and the installation of a filter on a plant's chimney of an end-of-pipe measure. If the environmental pressure is not prevented, the impacts it has (had or will have) on the environment can be restored (as long as the impact is reversible) or the impacts can be compensated by creating partial or complete alternative provisions for the environmental function lost. Furthermore, medical costs are environmental expenditures associated with the treatment of the impact of environmental damage on human beings, i.e. medical treatment, and finally yet importantly, security costs are environmental expenditures associated with safety regulations.

2.2 Problem of incomplete data or missing data

Data editing, imputation, evaluation, and data regulation are four ways to produce data that complement each other. When editing data, we are faced with the elimination of various types of errors, e.g. procedural or measurement errors (Groves et al. 2004). The goal of data editing is to find and correct as many errors as possible and thus improve data quality. Imputations are very closely related to data editing, which generally represent the process of replacing missing values. Estimates of statistical parameters, e.g. averages or proportions, and the associated variances, including confidence intervals, are the next step in the statistical data preparation process.

The terms "incomplete data" and "missing data" are closely related, sometimes even equating, because missing data identifies incomplete data and vice versa. The problem of missing data is therefore equally described as the problem of incomplete data (Vehovar 2011). Incomplete data can be treated in three ways (Vehovar 2011), namely:

- with the weighting method, where we try to correct the error in the estimates due to incomplete data with certain weights, e.g. post-stratification;
- by the method of direct analysis, where we analyse the existing (incomplete) data matrix, explicitly taking into account that we do not have data for certain fields, e.g. ML method (maximum belief method);
- insertion method, where instead of missing values we insert substitute values, for which there is considerable choice, from inserting the average value of observed units, using EM (Expectation-Maximization) algorithm to find ML (Maximum Likelihood) solutions to inserting more substitute values based on the Bayesian approach.

2.3 Imputation of missing values

In real statistical database, the occurrence of missing values is a fairly common occurrence for a variety of reasons. Such a challenge was also present and appropriately addressed in the database under this article (Eurostat, 2022). Literature presents several approaches to working with missing values (Kabir et al., 2019; Landrum & Becker, 2001; Vehovar, 2011). To properly analyse the dataset an adequate missing value imputation technique have to be applied. Imputation techniques (Kabir et al., 2019; Landrum & Becker, 2001; Vehovar, 2011) allows data imputation at every data unit in order to fill the dataset and allow the estimates and comparison of environmental protection expenditures across 32 European countries. Researchers demonstrate frequently applied data imputation approaches, i.e. imputation techniques, namely: the Buck method of imputation, “hot-deck” imputation, arithmetic mean imputation, and EM algorithm, among others. A holistic and detailed presentation related to different data imputation approaches, i.e. data imputation techniques is presented in the literature (Vehovar, 2011). In order to obtain most proper estimated of environmental protection expenditures, we applied the EM algorithm, that is, according to researchers (Callegaro et al., 2015; Rudas, 2008; Vehovar et al., 2008) very well establish technique for missing data imputation that delivers solid results. The EM algorithm (Expectation maximization) is a general iterative method for finding the maximum likelihood (ML) of parameter estimates when dealing with data that is incomplete or missing values (Dempster and Rubin 1983; Bilmes 1998). EM imputations are based on the insertion method which means that instead of missing values, we insert substitute values using the EM algorithm to find ML solutions (Dempster et al. 1977; Sundberg 1971; Vehovar 2011). In ML estimates, we want to estimate the parameter or parameters of the model for which the observed values are most likely (Borman 2004). In other words, a model procedure that represents a general algorithm for finding ML solutions in case of missing values. Minimum criteria to use EM algorithm is that observed panel data are measured on at least the interval level of measurement. The use of the EM algorithm in our model is an appropriate way to fill in the missing values, as the EM algorithm proves to be quite good at imputing panel data, while meeting the necessary conditions for its use, namely that variables are at least at interval measurement level. The EM algorithm works on the principle that in the first step it calculates the expected value of statistics, e.g. by stopping the averages, in the second step he inserts the obtained estimate into the expression for the expected value of the belief function or even in ML the solution of the belief function for the completed data. This process is repeated until the values converge (Vehovar 2011).

In terms of data reliability and validity of data and results different key assumptions have to be taken into account when using EM imputation. Firstly, data on the quality and accuracy of the variables are consistent across all EU Member States and harmonized by Eurostat, what makes our international comparison valid. Secondly, data on environmental expenditures in sector industry are positively correlated with actual costs of environmental regulations, which are expected to be the main motivator for environmental expenditures. In other words, environmental protection expenditures of companies represent a good proxy for the actual compliance costs with environmental regulations for private sector. Thirdly, international comparison between 32 European countries is reliable if data variables harmonized by Eurostat are consistent, comparable, of adequate quality, and accessible for the majority of European countries and for the selected study period (Le Roux et al., 2008). Further, we demonstrate the procedure for data imputation for analysed case.

2.4 Application of imputation to a specific case

The EM algorithm complements fields in the data that have missing data. Imputation procedure works in two steps. In the first step, for example, we guess the missing values. In the second step, we insert the data into the data, set up a regression model, and look at how good it is. We improve it until we get the optimal model. In the second step, we also learn how to correct the data to get an even better model, as the missing data is unknown in any case, for example, we analyse the distributions of individual variables (normal distribution, double normal distribution, flatness, asymmetry, etc.). similarity of distributions by country and by year. Based on this, we use the EM algorithm specifically for a similar sequence of years. If necessary, we logarithmise individual variables. We correct the data long enough to improve the data picture as much as possible. Negative, substantively meaningless values, e.g. the negative value of the state for environmental expenditure, which occurs when using the EM algorithm, is more appropriately replaced by 0. Missing data, which are properly substantiated or guessed, are inserted into the data and the model is checked. Then we do it again and put that "more adequate" data back into the model so we can see how the model fits. We strive to complete the picture of the data as appropriately as possible. We do not want to simply complete the data with averages for the whole distribution, e.g. in the case of a double normal distribution, but look for similarities in time series and use the EM algorithm to make more meaningful data for each distribution, which gives more relevant data. We avoid supplementing with the "bare average", as this can be difficult in practice to find theory-based laws and connections to existing data. The EM algorithm performs quite well in data imputation. As we already pointed out above, an important condition for the use of the EM algorithm is that the variables are at the interval measurement level or at least in the form of agreement scales, e.g. Likert scale. When performing imputations, there is also the possibility that the algorithm does not converge to a single global maximum, i.e. there is not a single point of convergence that is usually (but not necessarily) close. An example of such a deviation is the appearance of a "ridge" of the belief function, which reaches its maximum in a series of several related values ("likelihood ridge") (Schafer 1997; Vehovar 1995). The value of a variable is predicted from the set of variables to which this variable is related, which means that they are somewhat similar in content. Among the predicted values we can also get "invalid", e.g. on a scale of 1 to 5, a value of 6 or below 1 can be obtained, so these values must be rounded off accordingly. In this particular case, we are dealing only with numerical variables, there is a possibility that we get negative values, which we correct in a meaningful way.

In our case, we follow the example given by Vehovar (2011), namely: in the statistical software IBM SPSS 27.0 we set the years and countries as "dummy" variables, i.e. one for each year and one for each country. In other words, panel dataset consisted of key data, namely: environmental protection expenditures, dummy variable "year" and dummy variable "country". In this way, when completing the EM algorithm, the SPSS treats each country separately with the corresponding time series with respect to all countries and years. Using these variables, the SPSS performed EM imputation for each year and country independently. Proper set of other socio-economic variables e.g. GDP on land area, level of environmental taxation, total environmental taxes in industry sector, total government expenditures, proportion of eco-labelling licences per company, were also taken into account when performing EM imputation. Bellow, we demonstrate empirical results of the calculation and EM algorithm imputations through which we obtained the final value of environmental protection expenditure in the industry sector for companies for 32 European countries.

3 Results

This section demonstrates the results for the estimated environmental protection expenditures for 32 European countries. The results for the time series 2014–2018 are presented in Table 1 and demonstrate the finalisation of

1st step proposed by researches (Le Roux et al., 2008). In other words, the 1st step is to compare environmental protection expenditures in the industrial sector among the countries of the 32 European countries. Presented results are expressed as a share of environmental protection expenditures in the industry sector relative to each country's gross domestic product (GDP).

Table 1: Estimated environmental protection expenditures (EEPE) in industrial sector for 32 European countries

Country	EEPE in industrial sector 2017 (in % GDP)	EEPE in industrial sector 2018 (in % GDP)	Span of EEPE between 2014–2018 (min–max, in % GDP)	Difference in span of EEPE between 2014–2018 (min–max, in % GDP)	Maximum span of EEPE (in years)	Maximum span of EEPE (min–max, in % GDP)	Difference in a maximum span of EEPE (min–max, in % GDP)
Belgium	2,3	2,4	2,2–2,4	0,2	2014–2018	2,2–2,4	0,2
Bulgaria	0,9	0,8	0,8–1,6	0,8	2014–2018	0,8–1,6	0,8
Czech Republic	1,6	1,6	1,6–1,9	0,3	2014–2018	1,6–1,9	0,3
Denmark	1,1	1,0	1–1,2	0,2	2006–2018	0,9–1,2	0,3
Germany	1,4	1,4	1,3–1,4	0,1	2010–2018	1,2–1,4	0,2
Estonia	1,3	1,5	1,3–2,1	0,8	2014–2018	1,3–2,1	0,8
Ireland	0,2	0,1	0,1–0,3	0,2	2008–2018	0,1–0,5	0,4
Greece	0,1	0,1	0,1–0,2	0,1	2014–2018	0,1–0,2	0,1
Spain	0,8	0,8	0,7–0,8	0,1	2010–2018	0,7–0,8	0,1
France	0,9	1,0	0,9–1	0,1	2006–2018	0,9–1	0,1
Croatia	1,3	1,2	1,1–1,3	0,2	2014–2018	1,1–1,3	0,2
Italy	0,8	0,9	0,7–0,9	0,2	2008–2018	0,7–0,9	0,2
Cyprus	0,9	0,9	0,9–1	0,1	2010–2018	0,9–1,4	0,5
Latvia	1,0	1,1	0,8–1,1	0,3	2008–2018	0,7–2,2	1,5
Lithuania	0,7	0,9	0,6–0,9	0,3	2010–2018	0,6–1	0,4
Luxembourg	0,5	0,6	0,5–0,6	0,1	2008–2018	0,3–0,6	0,3
Hungary	0,9	0,9	0,8–1,2	0,4	2014–2018	0,8–1,2	0,4
Malta	0,3	0,3	0,3–0,5	0,2	2013–2018	0,3–0,5	0,2
Netherlands	1,0	1,1	1–1,2	0,2	2013–2018	1–1,2	0,2
Austria	2,8	2,8	2,6–2,8	0,2	2014–2018	2,6–2,8	0,2
Poland	1,0	0,5	0,5–1,1	0,6	2010–2018	0,5–1,1	0,6
Portugal	0,8	1,0	0,8–1	0,2	2014–2018	0,8–1	0,2
Romania	:	0,3	0,2–0,9	0,7	2006–2018	0,2–1,1	0,9
Slovenia	1,3	1,2	1,2–1,7	0,5	2008–2018	1,2–1,7	0,5
Slovakia	0,8	0,6	0,6–1,1	0,5	2008–2018	0,6–1,1	0,5
Finland	1,1	1,1	1,1–1,2	0,1	2014–2018	1,1–1,2	0,1
Sweden	1,0	1,0	0,9–1	0,1	2006–2018	0,8–1,2	0,4
Iceland	0,7	0,7	0,7–0,7	0,0	2014–2018	0,7–0,7	0,0
Norway	0,7	0,7	0,6–0,7	0,1	2015–2018	0,6–0,7	0,1
Switzerland	0,8	0,8	0,8–0,9	0,1	2006–2018	0,7–0,9	0,2
United Kingdom	0,6	0,7	0,4–0,7	0,3	2010–2018	0,2–0,7	0,5
Turkey	0,6	0,6	0,6–0,8	0,2	2013–2018	0,6–0,8	0,2

Source: Research (2022).

Results for 2018 demonstrate that the environmental protection expenditures in sector industry in 32 European countries on average increased for 0.46 % compared to 2017. Time series of the estimated environmental protection expenditures in industrial sector in the period 2006–2018 demonstrate an average increase of 0.8 % per year, with no increase on average observed in the period 2017–2018. Empirical results demonstrate that in 2018 Austria, Belgium, the Czech Republic and Estonia have the highest estimated environmental protection expenditures in industrial sector, ranging from 2.8 % to 1.5 % of GDP. Among the countries with the lowest estimates are Greece, Ireland, Romania and Malta, ranging between 0.1% and 0.3 of GDP. The highest environmental protection expenditures in industrial sector is reported in Austria (2.8 % for both years 2017 and 2018), followed by Belgium (2.4 %, and 2.3 % in year 2017), the Czech Republic (1.6 % for both years 2017 and 2018), and Estonia (1.5 %, and 1.3 % in year 2017). The lowest environmental protection expenditures in industrial sector is reported in Greece (0.1 % for both years 2017 and 2018), followed by Ireland (0.1 %, and 0.2 % in year 2017), and Romania and Malta (both countries 0.3 % for both years 2017 and 2018).

Table 2: Estimated environmental protection expenditures (EEPE) in industrial sector for 32 European countries in 2018, and difference in a maximum span of EEPE (in % GDP)

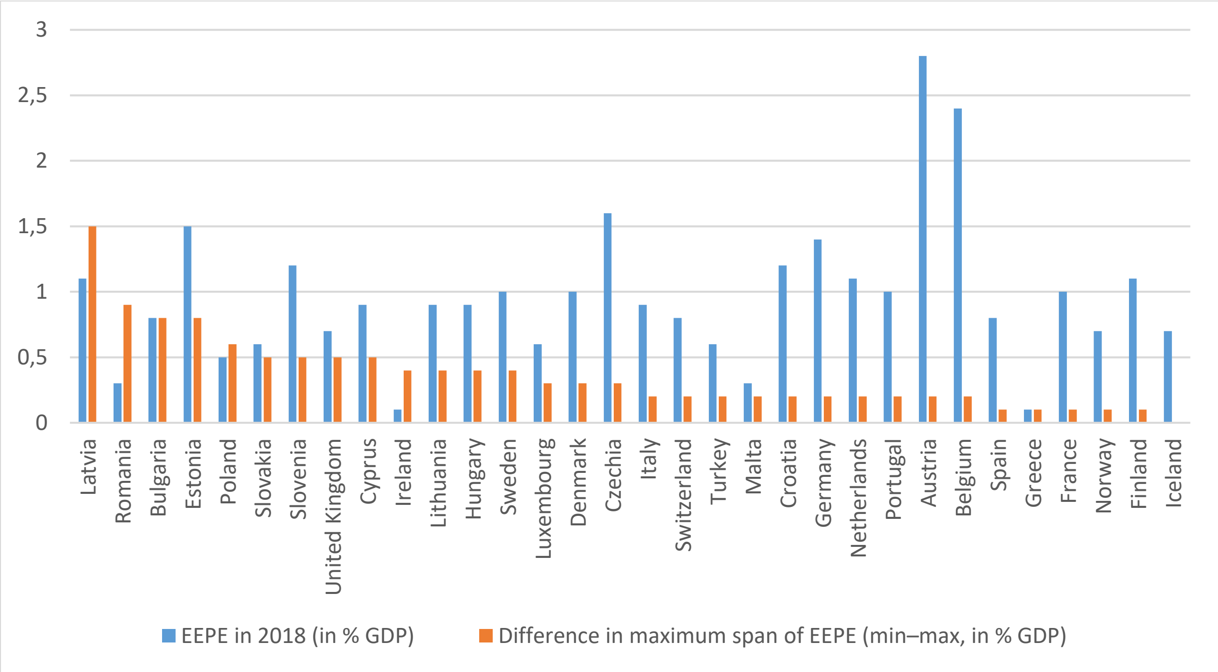

Table 2 presents the comparison between the estimated environmental protection expenditures in industrial sector for 32 European countries in 2018, and countries with the highest difference in a maximum span of environmental protection expenditures in industrial sector. Among countries with the highest environmental protection expenditures (in % GDP), the countries from the formed Eastern block stand out. The highest difference in a maximum span of environmental protection expenditures (in % GDP) is estimated in Latvia (1.5%). This is followed by Romania with estimated span of 0.9 %, Bulgaria and Estonia with estimated span of 0.8 %, Poland with estimated span of 0.6 %, and Slovakia and Slovenia both with estimated span of 0.5 %. The lowest difference in a maximum span of environmental protection expenditures (in % GDP) is estimated in Iceland with the span of 0.0 %. This is followed by Finland, Norway, France, Greece and Spain with estimated span of 0.1 %. The differences of countries' estimates of environmental protection expenditures can be attributed to various reasons. The most obvious reason for countries with highest difference in a maximum span of environmental protection expenditures (in % GDP) is their different historical background associated with their post-communist legacy and subsequent transition (Kotnik & Kovač, 2018). This was evident for example in Latvia, Romania, Bulgaria, and

Estonia. In these countries obvious changes have taken place through the adoption of a cumulative body of European Community laws (acquis communautaire), including the European environmental legislation. Since then, environmental legislation has been subject to extensive changes due to the introduction of ever-new environmental regulations, for example in the field of acquisition of environmental permits, trafficking of hazardous and radioactive materials, and construction of oil and gas networks in these countries.

4 Conclusion

This article discusses an alternative approach for the evaluation of compliance costs with environmental regulations in industrial sector. It uses the methodological approach developed by researches (Le Roux et al., 2008), who propose that the costs of compliance with environmental regulations in industrial sector are actually positively correlated to the assessed environmental protection expenditures in industrial sector, and can therefore be used as a proxy to properly assess the costs of private sectors, related to environmental regulation obligations. In this paper, we presented the results of the first step of this methodology (Le Roux et al., 2008) for the comparison of compliance costs with environmental regulations for businesses.

Results for 2018 demonstrate that environmental protection expenditures in sector industry in 32 European countries on average increased for 0.46 % compared to 2017. Time series of the estimated environmental protection expenditures in industrial sector in the period 2006–2018 demonstrate an average increase of 0.8 % per time point. Results of the empirical analysis demonstrate that in 2018 Austria, Belgium, the Czech Republic and Estonia have the highest estimated environmental protection expenditures in industrial sector, ranging from 2.8 % to 1.5 % of GDP. Among the countries with the lowest estimates are Greece, Ireland, Romania and Malta, ranging between 0.1% and 0.3 of GDP. Especially interesting results are of those countries with the highest difference in a maximum span of environmental protection expenditures (in % GDP), i.e. Latvia, Romania, Bulgaria, Estonia, Poland, Slovakia, and Slovenia. These countries come from Eastern Europe who in the past shared a similar socio-political tradition of a Soviet type. Later in the 1990s, after the fall of the Berlin Wall and the collapse of communism, these countries from the former Eastern block shaped a tendency towards the market-oriented and democratic economy (Kovač & Bileišis, 2017). This was demonstrated in the adoption of pro-Western policies, the integration of their economies into the European single market, and the adoption of the European acquis, which was also reflected in the rise of the estimated environmental protection expenditures.

This article also adds knowledge to dealing with missing values. It presents an adequate approach of filling in the missing values for the assessment of environmental protection expenditure in the industry sector, which serves as a first step to further assess compliance costs of businesses with environmental regulations. The article demonstrates that the expected-maximization (EM) algorithm turns out to be the most adequate methodological tool to fill in the missing values and thus to estimate the parameters of environmental expenditure in the industry sector for individual countries. In the next phase of the research, we will perform a second step to estimate the compliance costs for business related to environmental regulatory obligations, which will include using the Environmental Regulatory Index (Porter and Esty, 2001) for comparison between selected countries. In the third step, we will compare the quality of the environment of each country with other countries based on criteria (SO_2, PM_{10} and energy efficiency). This will give us a final estimate of the compliance costs of private sector in relation to environmental regulatory obligations.

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