EVALUATING THE REGULATORY BURDEN: POLLUTANT RELEASE AND TRANSFER REPORTING COSTS

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Abstract
Environmental information disclosure instruments inevitably also carry information costs. It is important to pay attention to these costs because of the competitiveness issues connected with the regulatory burden of the private sector or the overall cost-effectiveness of different types of environmental regulation from the public sector point of view.
We undertake an *ex-post* analysis to quantify and analyse reporting costs of private sector induced by the European Pollutant Release and Transfer Register (E-PRTR). We focus on the case of the Czech Republic. The average annual reporting costs, additional to other reporting duties, are € 365 *per* facility. The Czech PRTR comprises 8 times more facilities than required by the European law, and thereby increases correspondingly the total reporting costs. The best predictor variable of the costs is the need for measuring or calculating additional releases or transfers beyond the information requirements of other registers.

Keywords: reporting costs, information costs, PRTR, environmental information disclosure
JEL Classification: Q58, Q53, L59

1. Introduction

Numerous information instruments regarding harmful substance disposal and pollution releases have been adopted recently across various countries. The right to be informed is embodied in the UNECE Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters. The duty to inform about pollution from industrial sites and other significant sources through a register is embodied in the international agreement called the Kiev Protocol on Pollutant Release and Transfer Registers. This protocol requires implementation of nationwide pollutant release and transfer registers (PRTR) in the participating countries. On the EU scale, there is the European Pollutant Release and Transfer Register (E-PRTR), which gathers data on significant pollution disposals and transfers – *i.e.* everybody, including EU citizens, should easily access information on where and by whom selected pollutants (in amounts

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exceeding a threshold) are transferred or discharged into the environment. The E-PRTR was established by Regulation (EC) No. 166/2006. Thereby the previous EPER (European Pollutant Emission Register) was replaced.

Also countries not participating in the Kiev Protocol have established similar instruments disclosing environmental information about significant pollution releases and transfers on a voluntary basis, since enforcement of the right to be informed is not an aim for itself. Uncovering true pollution from significant sources may serve as a *quasi*-regulatory instrument of environmental policy. Pollution registers are therefore sometimes referred to as the third wave of environmental regulation (Tietenberg, 1998; cf. Biglaiser, Horowitz, 1993) following the waves of command-and-control and economic instruments. Information disclosure creates not only social pressure from the media or environmental organisations, but also from cooperating entities, consumers and investors (Cañón-de-Francia *et al.,* 2008; cf. Oberholzer-Gee, Mitsunari, 2006). A positive influence of information disclosure on pollution decrease is demonstrated by the US Toxic Release Inventory (*e.g*. in Khanna *et al*., 1998; Harrington, 2013). Cañón-de-Francia *et al.* (2008) use Spanish enterprises within the EPER to demonstrate the penalisation of highly polluting companies listed in the EPER *via* a fall in their share prices.

The creation of new information instruments, however, has a dark side regarding the information costs considered as transaction costs – *i.e*. additional costs must be taken up by the public as well as the private sector to make any register operational. New information systems are only rarely fed with existing data. Therefore, private companies are burdened with extra reporting duties. It is important to pay attention to these costs because of the competitiveness issues connected with the regulatory burden on the private sector as well as the cost-effectiveness viewpoint of different types of environmental regulation. Costs of environmental regulation have been increasingly studied (Jaffe *et al*., 1995; Goulder *et al*., 1999; Ryan, 2012) including solely transaction costs (Krutilla and Krause, 2011; McCann, 2013) to enable regulatory impact assessment.

An effort for the measurement of pollution release and transfer information costs has already been made by the UNECE (2011). The UNECE study develops a model for prospective calculation of PRTR costs when implementing PRTR under the Aarhus Convention (UNECE n.d.). The UNECE cost model focuses on the incremental costs related to the PRTR introduction (UNECE n.d.). This is closely connected to the level of information requirements existing before the PRTR introduction in particular countries. The UNECE methodology strongly focuses on the costs connected with reporting of releases or transfers of particular polluting substances.

In our paper, we focus on overall reporting costs, also generally labelled as compliance costs (see, *e.g*. Bennet *et al*., 2009), under the PRTR regime of particular facilities (corporations comprise of 1 or more facilities). In accordance with the UNECE study (2011), we calculate the incremental burden of this regulation. The main goal is to reveal the average burden for facilities reporting to the PRTR and to investigate factors causing variability in the burden sizes (such as types of costs, types of substances reported by one facility, *etc*.). Assessing regulatory burden on the private sector helps to develop sound policies, eliminate regulation overlaps and, in general, it reflects the regulatory proportionality principle (Vítek, 2012).

Our *ex-post* analysis based on a questionnaire survey among pollution and transfer reporting facilities was undertaken in the Czech Republic, a Central European country

and an EU Member State. This method belongs to the family of partial equilibrium analyses, where the focus of analysis is limited to agents directly influenced by a regulation. The data collected were statistically analysed using the R language (R Core Team, 2012).

The structure of the paper is as follows: Section 2 brings an insight into methods of evaluating compliance costs of environmental regulation in general. Section 3 discusses the Czech specifics concerning environmental pollution release and transfer reporting and the survey methodology. Section 4 introduces detailed results of the survey. Section 5 brings more insights into our results to enable policy-makers also beyond the Czech Republic's borders to make use of these results.

2. Costs of Environmental Regulation and Their Evaluation

We can distinguish among general and partial equilibrium analyses of costs of environmental regulation. In our paper, we will concentrate on partial equilibrium costs which represent pecuniary as well as nonpecuniary costs borne by directly influenced entities – companies, households, governments (Pizer and Kopp, 2005). One of the best-known retrospective partial equilibrium studies, analysing behaviour already manifested on the market, is the US Pollution Abatement Costs and Expenditures (PACE) study, which has been undertaken since the 1970s (for the latest PACE data, see the US Census Bureau, 2008). As stated by Joshi *et al*. (2001), these studies cannot be based on internal accountancy books, which may divide costs according to their types, for instance an environmental regulation costs account. Only direct costs are included in this account, such as additional environmental technology costs. These accounts do not include, for instance, a change of production technology as such. Joshi *et al*. (2001) show that a $1 marginal cost increase included in the "costs of environmental regulation" account leads to a $10 marginal cost increase to all costs connected with environmental regulation. Therefore, rather a questionnaire survey, used also in the PACE study, is preferred to uncover the costs of environmental regulation.

Reporting costs of private enterprises in connection with the PRTR may be calculated similarly to the compliance costs in connection with the tax liability of entities (*e.g*. in Tran-Nam, 2000; Bennett *et al*., 2009). Similar applications for cost calculation can also be found in the area of environmental protection, such as compliance cost calculation induced by EIA processes (EC, 1996; Retief and Chabalala, 2009). All of these studies may be classified as retrospective partial equilibrium studies based on a questionnaire survey.

It follows that partial equilibrium analyses cannot show an exact picture about the total costs of environmental regulation. Their results show the direct impact on particular affected entities very well. They neither capture losses from closings of running enterprises or from fewer new enterprise launches after the introduction of a regulation if the costs of regulation are excessively high. If product prices of regulated companies increase, the consumption of their goods goes down, which is associated with a loss of consumer welfare, also not included in the costs calculated by these partial equilibrium studies (Pizer and Kopp, 2005). The criticism of omitting regulatory impacts can be applied to any partial equilibrium calculations of costs of environmental regulation.

Specific concerns apply to questionnaire surveys. Groves (2004) distinguishes following sources of survey error: i) sampling error, if data about the entire population are not used; ii) coverage error if a selected part of population has no statistical chance to be

included into the sample; iii) measurement error connected with poor questionnaire design leading to misinterpretation of questions, as well as the influence of the interviewer on respondents' answers, making respondents unable to answer the questions correctly, and the selection of the data collection mode; and iv) non-response error if non-respondents systematically differ from the respondents. According to Dillman and Bowker (2001), the higher the response rate, the lower the danger of a severe non-response error can be expected. As Portney (1981) states, respondents may face difficulties specifically in distinguishing the costs of environmental regulation from the other costs.

Our study is a retrospective analysis of reporting costs, using data gathered by a questionnaire survey among individual facilities, which belongs to the family of partial equilibrium analyses of costs of environmental regulation (cf. Pizer and Kopp, 2005). We will calculate strictly the costs of facilities and will not take into account the costs of households or government.

3. Czech Register and Method Used to Evaluate Reporting Costs

The existence of the Czech Pollutant Release and Transfer Register (CZ-PRTR) is regulated in the Czech Republic by Act No. 25/2008 Coll. on the CZ-PRTR and Government Regulation No. 145/2008 Coll., laying down the list of pollutants, threshold values and information required for reporting to the CZ-PRTR. Compared to the E-PRTR, the extent of information is stricter and includes additional categories of facilities in the reporting duty. There were overlaps among the categories (some facilities report the pollutants in various record-keeping categories). These overlaps have been eliminated for the purposes of this study in collaboration with the Czech Ministry of the Environment. Table 1 summarises the numbers of facilities in the different categories, including facilities falling into the E-PRTR, which make up only 12.6% of the total number of facilities registered in the CZ-PRTR. It is therefore interesting to follow the reporting costs from the perspective of not only the cost-effectiveness of the European system in the Czech Republic but also the additional costs caused by the national legislation beyond the scope of the European regulation.

Table 1 | CZ-PRTR Categories

Category	Number of facilities	Percentage rate
Facilities falling into E-PRTR (E-PRTR)	624	12.6
Facilities discharging styrene and formaldehyde (SF)	55	1.1
Facilities with lower production capacity than E-PRTR facilities (Low_cap)	1,988	40.3
Facilities with different economic activity than E-PRTR facilities (Other_activity)	1,857	37.6
Facilities with off-site transfer other than included in E-PRTR (Trans)	409	8.3
Total	4,933	100

Source: Ministry of the Environment of the Czech Republic, 2011

The reason for the more extensive reporting duty beyond the scope of the E-PRTR is based directly on the Czech legislation adopted in the 1990s. In different acts of law and decrees, the system included the duty to report the emissions of various substances under uncoordinated registers managed by various entities (both state administration and self-government). For these reasons, and due to the objective of the Ministry of the Environment to have comprehensive information about pollutants released directly from its own register, these and other pollutants were automatically included in the CZ-PRTR register.

3.1. The approach to reporting cost measurement

We calculate the reporting costs for facilities connected to the PRTR located in the Czech Republic. Because the Czech legislation goes beyond the requirements of the E-PRTR, we also evaluate the incremental regulatory burden for these facilities due to the additional requirements of the Czech legislation. We consider costs of environmental reporting prior to the PRTR introduction as the zero baseline for our analysis. We presume no change in other reporting duties in connection with the CZ-PRTR introduction for the calculation of the CZ-PRTR reporting costs. The costs of other reporting duties are not included in the reporting costs connected to the introduction of the CZ-PRTR. The total costs of environmental reporting of facilities are therefore much higher.

The different types of induced costs and the method for calculating them are summarised in Table 2. The study first makes a distinction between one-off and recurring costs. The one-off costs (expended once every several years depending on the lifetime) include, among other things, new measurement software. The recurring costs are incurred by facilities in connection with compliance with their reporting duties every year. All the induced costs examined within the questionnaire survey were stated by the respondents as annual (*i.e.* reflecting the logic of recurring costs). This means that one-off costs were spread over multiple years taking into account the number of years to which they apply. Except for wages, costs reflect the true facilities' expenses in nominal prices of the year 2011. The exchange rate of 25.14 CZK/€ was used.

Table 2 | Types of Costs and Methods for Calculating Them

Induced costs	Calculation method
Wages	Number of hours *per* year multiplied by the average annual wage of staff concerned with reporting to the CZ-PRTR which is based on the data of the Czech Statistical Office and includes all tax levies. The hourly wage ranges from € 5.3 up to € 42.6 according to the position of the person responsible.
In-service training	Annual costs connected to staff in-service training.
Software and technology	Annual costs corresponding to depreciation; costs of annual software upgrades.
Measurement or calculation	Annual costs connected to measurement or calculation of the amount of pollutants other than included in other cost categories.
Outsourcing	Annual costs associated with reporting to the CZ-PRTR arising from agreements with contractors.

Source: authors, based on Jílková *et al.* (2006) and Tran-Nam *et al.* (2000)

In our study, the reporting costs did not include costs associated with acquisition of other additional tangible or intangible assets, and other costs in the form of postage and telephone fees, travel costs, and the like (not applicable or considered negligible).

3.2. Data collection

The data for the quantification of the induced costs were acquired directly from the regulated facilities based on a structured questionnaire. In compliance with the logic of the CZ-PRTR records, "facility" or "respondent" refers to a facility of a corporation (corporations have one or more facilities).

The data collection took place in two stages (2011 and 2012). Data were collected for the years 2010 and 2011. In both the survey years, we selected a sample representing 2.5% of the total number of reporting facilities out of each CZ-PRTR category (see Table 1). The exception was the CZ-PRTR category discharging styrene and formaldehyde, in which we approached 6% of facilities. The reason for this increased number of respondents was the low number of entities registered in the category. Our sampling method was to include in the survey pool every x^{th} facility out of each CZ-PRTR category, in which facilities were organised according to the CZ-NACE codes. We collected 81 questionnaires in the first stage and 80 in the second stage, totalling 161 questionnaires. We approached a total of 267 facilities during the collection, so the return rate is 60.3%. This high return rate was caused by the data collection method, which used personal telephone communication accompanied with e-mail communication. The questionnaires were completed either directly during the telephone call followed by an e-mail data check, or the questionnaire was completed directly by the facility approached (contact person) and sent to the organiser by e-mail. We believe that any deficiencies of questionnaire surveys, such as failure to understand the questions, are tackled adequately in this study due to the sample size selected and the questionnaire method, combined with an oral conversation with respondents.

The character of the CZ-PRTR did not change fundamentally in the course of the reporting cost survey. It was therefore possible to draw up a synoptic set of 161 respondents showing their costs of data reporting to the CZ-PRTR for 2011. The data acquired for 2010 were transferred as follows for the analysis purposes: (i) the hourly rates published by the Czech Statistical Office in 2011 were used for the personnel cost calculation (the respondents only stated the position of the person responsible and time demand in hours); (ii) the conversion of the other costs (outsourcing, measurement and software) reflected the inflation trend in 2011, *i.e.* an overall market service price index of 0.91% was applied; (iii) the impact of legislative change was reflected in the data sample for 2010 (the number of reported pollutants in the area of pollutant transfer in waste was reduced for the following year), *i.e.* 6 respondents out of the data sample for 2010 (7.4% of the total) had their number of reported pollutants reduced by 3 on average. When approached again, these facilities quantified a cost saving between 0 and 199 euro.

The approached facilities can be divided into the following groups based on the NACE classification: C – manufacturing (89 facilities); A – agriculture, forestry and fishing (15 facilities); B – mining and quarrying (4 facilities), D – electricity, gas, steam production (6 facilities); E – water supply, sewerage, waste management and remediation (11 facilities); F – construction (8 facilities); G – wholesale and retail trade, repair of motor vehicles (13 facilities); H – transport and storage (4 facilities); others – health and social care, education, science and research, administration (11 facilities).

4. Results

Table 3 brings descriptive statistics of variables. It is possible to infer, that many facilities do not face any incremental costs in some cost types connected to reporting duties to CZ-PRTR above the regulatory burden prior the CZ-PRTR introduction. Incremental costs of training were incurred by only 20% facilities, of software 2% facilities, of measurement and calculation 15% facilities, and outsourcing 46% facilities.

Table 3 | Descriptive Statistics of Variables

	Total study sample (n=161)						
Quantitative variables	**Mean**	**Median**	**Min**	**Max**	**IQR***	**Skew**	**Kurtosis**
Total costs [€]	405.0	226.7	19.9	4,292.1	223.9	3.7	14.4
Wages [€]	176.0	144.5	0.0	902.8	187.9	1.7	3.8
Training [€]	14.0	0.0	0.0	167.0	0.0	2.3	5.0
Software [€]	6.7	0.0	0.0	795.4	0.0	11.7	140.2
Measurement, calculation [€]	141.0	0.0	0.0	3,977.1	0.0	4.7	24.3
Outsourcing [€]	67.4	0.0	0.0	1,789.7	73.7	6.7	54.5
Number of employees	234	80	2	5,660	205	7.1	63.2
Categorical variables							
Measurement, calculation Y/N	Yes = 24; No = 137						
Outsourcing Y/N	Yes = 74; No = 87						
E-PRTR Y/N	Yes = 27; No = 134						
Categories based on Table 1	E-PRTR = 27; SF = 8; Low cap = 55; Other activity = 50; Trans = 21						

Note: *IQR… Interquartile range

Source: authors

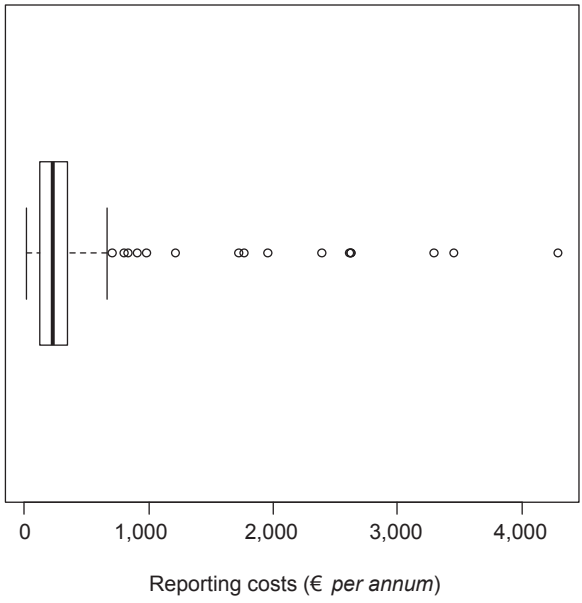
The data of annual reporting costs are characterised by a high level of skew with a non-normal distribution (with a skew of 3.7 and a kurtosis of 14.4, see also Figure 1). The calculation of the standard deviation of the dataset is inappropriate in this case.

To be able to apply statistical inference to our dataset, we normalised our reporting cost data (*i.e.* transformed our variable to obtain a new variable with a normal distribution) using a natural logarithm. This transformation turned out to be suitable for obtaining a normal distribution. Our normalised variable has a low value of both skew (0.6) and kurtosis (0.9).

The mean (€ 365.2) and the confidence interval for the mean (€ 304.5, € 438.1) for the annual reporting costs was calculated using the log transformation of our variable and

the Cox method (Olsson, 2005)[1]. The mean calculated in this way is lower than the mean based on raw data (€ 405.0). With the same method we tested the effect of the non-occurrence of the 3 outliers with the highest reporting costs on the result. The mean based on raw data excluding 3 outliers is € 342.9, and using the Cox method is € 325.4 with the confidence interval for the mean (€ 275.5, € 384.3). As we can see, the removal of the 3 outliers with the highest reporting costs decreases the calculated mean. Because the high level of skew with outliers is typical for our dataset, we consider the approach without outliers' elimination as more relevant and will use the complete dataset in the further analysis.

Figure 1 | Distribution of Reporting Costs (€ *per annum*)



Source: authors

We proceeded with testing of influence of different variables on the annual reporting costs using multiple regression analysis. Tested variables describe the division of facilities into categories (Category), see Table 1; the need/non-need for emission measurement or calculation beyond the scope of other registers (Measurement, calculation Y/N); the use/non-use of outsourcing (Outsourcing Y/N); the number of employees as the proxy of the firm size (Employees). For variable Category, dummy coding was used to distinguish between 5 types of categories (Category E-PRTR is the baseline category for dummy coding).

1 The method is based on constructing a confidence interval for the log-normal distribution variable (X) using the transformed variable $Y = \log(X)$. The results are back-transformed thereafter.

The confidence interval for log (X) is defined as $\overline{Y} + \frac{S^2}{2} \pm z\sqrt{\frac{S^2}{n} + \frac{S^4}{2(n-1)}}$, where z is the right percentage point of normal distribution.

The results of multiple regression analysis (see Table 4) show the intercept and the variable "Measurement, calculation" as significant on the significance level $\alpha = 0.05$. No other variable influences statistically significantly annual total costs. Therefore we deduce from the analysis, that there is no statistically significant effect of the firm size in terms of the number of its employees, or of the use or non-use of outsourcing to perform reporting duties. There is also no association between reporting costs and the division of facilities into the categories.

Table 4 | Results of Multiple Regression I – Dummy Coding of Variable Category

	Null hypothesis significance testing				Confidence interval	
	Regression Coefficients	Std. error	t value	Pr (>|t|)	2.50%	97.50%
Intercept	5.2033	0.1619	32.1390	$< 2e^{-16}$	4.8834	5.5231
Measurement, calculation Y/N	1.5391	0.1760	8.7430	$3.80e^{-15}$	1.1913	1.8869
Outsourcing Y/N	0.0729	0.1269	0.5750	0.5660	−0.1777	0.3236
Employees	0.0002	0.0001	1.3380	0.1830	−0.0001	0.0004
Category code Low cap	−0.0052	0.1853	−0.0280	0.9770	−0.3713	0.3608
Category code Other activity	−0.2773	0.1913	−1.4490	0.1490	−0.6553	0.1007
Category code SF	−0.0727	0.3211	−0.2270	0.8210	−0.7071	0.5616
Category code Trans	0.1485	0.2353	0.6310	0.5290	−0.3164	0.6134
Multiple R-squared: 0.3758						

Source: authors

Table 5 | Results of Multiple Regression II – Testing the Influence of the E-PRTR Category

	Null hypothesis significance testing				Confidence interval	
	Regression Coefficients	Std. error	t value	Pr (>|t|)	2.50%	97.50%
Intercept	5.1109	0.1002	51.0220	$< 2e^{-16}$	4.91303	5.30876
Measurement, calculation Y/N	1.5661	0.1754	8.9300	$1.12e^{-15}$	1.21968	1.91254
Outsourcing Y/N	0.0472	0.1263	0.3740	0.7089	−0.20217	0.29662
Employees	0.0002	0.0001	1.9140	0.0574	−0.00001	0.00045
E-PRTR Y/N	0.0824	0.1690	0.4880	0.6265	−0.25146	0.41628
Multiple R-squared: 0.3551						

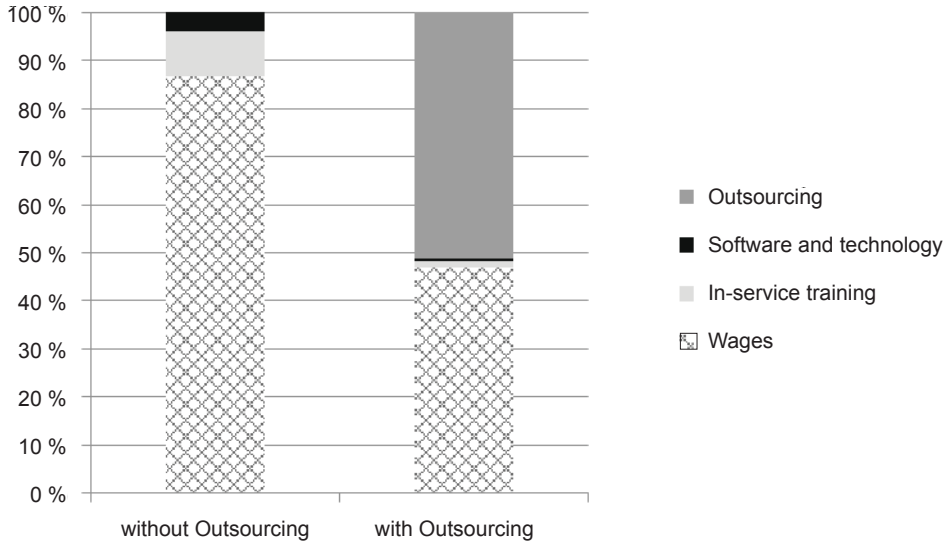
Source: authors

Because the E-PRTR category from its definition comprises the biggest emitters, we are particularly interested if there is an association between the reporting costs and the occurrence of particular facilities in the E-PRTR category. Therefore we undertook multiple regression analysis II using the same variables as in the model above, just instead of the dummy coding of all the categories we used a new categorical variable showing the presence of the facility in the E-PRTR category (E-PRTR Y/N). As we can see in Table 5, there is no association between the reporting costs and the occurrence of the facility in the E-PRTR category.

Since these categories do not have a statistically significant effect on the costs, we will regard the facilities' costs as invariable across the categories for the purposes of the further analysis.

There is an association between the height of the annual reporting costs and the necessity of measurement or calculation of additional releases or transfers for the CZ-PRTR. Cohen's d value of 1.998 identifies a large effect of this variable. Again, we applied the Cox method to the calculation of the mean of the annual reporting costs for facilities which do not need to measure or calculate new pollutants (€ 236.5) as well as the mean of the annual reporting costs for facilities which do need to measure or calculate the amount of additional substances (€ 1,559.9). The former value indicates the level of minimum costs of reporting if the same substances are reported to a new register. These results also indicate how the reporting costs increase if measurement or calculation is required for new substances.

Figure 2 | Division of Annual Reporting Costs



Source: authors

Figure 2 shows the division of the annual reporting costs among the cost types (see Table 2) according to the use / non-use of outsourcing for the subset of facilities which do not need to measure or calculate emissions beyond the scope of other registers. As it is

possible to infer from Table 4 and Table 5, the use / non-use of outsourcing influences solely the cost structure, not the overall height of reporting costs. The most important cost item there are wages and outsourcing. The costs associated with training of staff and software comprise a minor part of the costs of both the groups.

We now proceed to calculate the total incremental reporting costs of CZ-PRTR for the Czech Republic. We will base the inference on the mean calculated using the transformed variable $Y = \log(X)$. Because the differences across the groups of facilities were shown to be statistically insignificant, we will multiply the mean reporting costs (€ 365.2 *per annum*) by the number of facilities reporting to the CZ-PRTR (4,933). The total incremental costs of reporting to the CZ-PRTR are € 1,802,000 *per* annum with the 95% confidence interval € 1,502,000–2,161,000 *per annum*. We have to bear in mind that only the direct reporting costs of regulated facilities were calculated. The real incremental burden, also taking into account indirect costs (costs of indirectly influenced entities) and invisible costs (*e.g.* loss from facility closures due to excessive burden), will therefore most probably be higher.

Because the CZ-PRTR requires a more complex reporting than the E-PRTR, we calculated the incremental costs of the CZ-PRTR in comparison with the E-PRTR for Czech facilities. The results of tests shown above indicate that the difference in the costs across the groups of facilities defined in Table 1 is not statistically significant. Therefore, for the calculation of the incremental burden of the CZ-PRTR system, we used as an input solely the numbers of E-PRTR and other facilities. The Czech legislation increases the costs associated with the duty to report data to the CZ-PRTR by € 1,574,000 *per annum*, which is more than 87% of the total reporting costs (average costs *per* entity of € 365.2 *per annum* multiplied by the number of facilities reporting to the register solely due to Czech incremental requirements, namely 4,309). Since some facilities violate the requirement of reporting, the real reporting costs would be higher under their compliance. The incremental burden of the E-PRTR in the Czech Republic is € 228,000 *per annum*, which is about 13% of the total reporting costs. However, the reporting of pollutants under the E-PRTR cannot be easily separated from the reporting of the other pollutants, because some of the facilities reporting under the E-PRTR report other pollutants under the CZ-PRTR. The calculated value may therefore be considered the upper estimate of the incremental burden of the E-PRTR for the Czech Republic.

5. Relevance of Survey Results for Decision-Makers

The following conclusions arose from the detailed analysis of compliance costs induced by the CZ-PRTR:

- The average reporting costs *per* facility are approximately € 365 *per annum*.
- The best predictor variable of the reporting costs is the need for measuring or calculating additional releases or transfers beyond other registers.
- The average reporting costs for facilities which do not need to measure or calculate new emission substances are € 236.5 *per annum*, which indicates the minimum costs of reporting if the same substances are reported to another register. The mean of the reporting costs for facilities which measure or calculate the amount of additional substances is much higher. On the example of the Czech legislation, it is € 1,559.9 *per annum*.

- A large amount of facilities (46% of our sample) use external advisors to meet their reporting duties. The use / non-use of outsourcing does not influence the overall reporting costs.
- Wages and outsourcing represent the most significant cost categories.
- The total reporting costs of the CZ-PRTR are caused mainly by Czech reporting requirements, which are stricter than the EU legislative duties. The CZ-PRTR comprises only 12.6% of facilities covered by the European law. Reporting duty of other facilities is brought solely by the stricter Czech law. Total reporting costs of the CZ-PRTR are correspondingly higher in comparison with the E-PRTR requirements.

The results indicate that the introduction of the register has brought perceptible transaction costs for facilities located in the Czech Republic. It is not possible to compare our result with corresponding studies. To our best knowledge, there is no study assessing incremental burden for firms arising from the E-PRTR or any other similar information instrument. The research of other areas of interest shows, however, that transaction costs do matter and cause changes in firm behaviour. On the case of the EU ETS trading scheme, Jaraitė-Kažukauskė and Kažukauskas (2014) demonstrate the decrease in the number of trading operations in comparison with an efficient level due to transaction costs incurred. In the context of the CZ-PRTR scheme, companies cannot release from bearing reporting costs but circumvent the Czech law. Transaction costs might be the reason for a lower number of facilities participating on the CZ-PRTR than required.

Reporting costs can be justified in connection with social benefits that arise from the existence of the complex information tool. Also firms by themselves can benefit from the increased transparency within the market. A comprehensive study evaluating these benefits on a Czech or European scale has not been developed yet. However, partial studies show a significant positive impact of PRTR introduction (Harrington, 2013; Cañón-de-Francia *et al*., 2008).

Also, the reporting costs of the PRTR cannot be judged in isolation, but in the overall context of the reporting effectiveness. During the survey, respondents often mentioned duplications in the reporting duties resulting from the low co-ordination of databases kept by the various public offices. From this point of view, the introduction of the new register has often doubled the reporting duties instead of replacing older segmented databases with a new aggregate one. Furthermore, respondents indicated that the usability of the CZ-PRTR for end users (the public) is questionable regarding its design and a lower number of participating facilities than required by law – this indicates the question to what extent the responsible body is able to enforce and control the reporting.

Based on these facts, we would recommend a rethinking of the Czech concept of the comprehensive PRTR and exclusion of facilities with rather insignificant environmental impacts – as mentioned earlier, the Czech version of the register is much stricter and enlarges the reporting obligation to large number of additional facilities (*e.g*. low capacities, substances other than those targeted by the EU, *etc*.). In this context, Crain (2005) mentions firms up to 20 employees as the most threatened by the environmental regulation costs. These firms often represent a large number of entities in the economy with a low contribution to the overall environmental impact in total. In our sample, there were about 12% of facilities with up to 20 employees. As the analysis shows, they have to face the same

annual reporting costs on average as large facilities – there is no statistically significant size effect on annual reporting costs based on number of employees. Another way to rationalise regulation duties would be to interconnect existing databases and to eliminate reporting duplications (by transferring data from one database to another or by unifying the reporting forms).

By such proposals, we do not intend to undermine the importance of shared (European) PRTR registers, which are focussed mainly on capturing large polluters. In such cases, the value added of information sharing as well as the potential environmental threats are significant – and therefore, they most probably justify the reporting costs. What we stress, however, is the existence of an uneasily identifiable cost proportionality or regulation adequacy that has been often mentioned on the EU scale in the context of other European policies. We are persuaded that the Czech case demonstrates the situation in which compliance costs of PRTR reporting are disproportionate to the expected benefits.

6. Conclusion

Within the research undertaken, we analysed additional reporting costs carried by facilities due to the introduction of a new information tool of the EU environmental policy. The concern of the (redundant) regulatory burden has been recently emphasised regarding the decreasing competitiveness of the European industry. Although the need to measure costs of environmental regulation is emphasised, only few studies have been undertaken.

Our case study investigates the situation regarding the PRTR enforcement in the Czech Republic. In a survey of 161 facilities (which together represented more than 3% of the reporting facilities), the results indicate an average burden of a facility of about € 365 *per annum* and the main factor influencing the cost size being the necessity of measurement or calculation of new pollutant releases. With respect to the survey design, we have experienced the challenges of a proper questionnaire design to be able to comprehensively capture all the relevant costs and to get the right answers to our questions from respondents as well as how to evaluate reporting cost differences for facilities reporting different pollutants. In spite of that, we consider our results robust and statistically relevant.

The calculated average individual and total reporting costs are necessary inputs for the discussion about the proportionality of regulation – such as the cost-benefit relationships or rationalisation of the environmental regulation burden for small and medium enterprises. These aspects are relevant especially in the case of overlapping duties (*i.e.* when a national regulation is complemented by an international one). Particularly, it has been revealed in our case study that significant reporting costs are induced mainly by the Czech legislation through which the new EU register has been implemented. Facilities that need to report according to EU requirements represent no more than 13% of the total facilities within the CZ-PRTR. The rest of the facilities have different economic activity, lower production capacity, or report other pollutants than those required by the European law. Therefore, in order to optimise the level of total reporting costs induced by the PRTR, discussions about the minimum size of regulated facilities or the size of the potential environmental threat seem to be highly relevant for the future evolution of the information tools introduced.

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