Causal impacts of the REACH Authorisation process on the use of substances of very high concern in the EU

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Executive summary

This report presents two case studies that seek to quantify the causal effects that regulatory actions under the REACH Authorisation title have had on the use of specific substances of very high concern (SVHCs) in the EU/EEA. The main results found in these case studies can be summarised as follows.

- *Five years after the entry to Annex XIV (the Authorisation List), Swedish firms had reduced their annual use of SVHCs requiring authorisation by about 40 %. This is a strong finding which suggests that the inclusion of a substance in the Authorisation List has a sizeable substitution effect. However, data and studies from other Member States would need to be checked if this finding is generalisable to the whole EU.*
- *Adding substances to the REACH Candidate List may reduce their releases to wastewater. The most robust effect in that regard was found for 1,2-dichloroethane, the discharge of which had declined by about 66 % over the period 2011-2017. It seems at least plausible to attribute this cutback to reductions in the use of the substance that firms made in response to its inclusion in the Candidate List and its anticipated inclusion in the Authorisation List. Results of similar analyses for (ethoxylated) nonyl- and octylphenols were not robust.*

This report is one of the first attempts to find a causal relationship between regulatory action under the REACH Authorisation title and the use of SVHCs. The results of two case studies indicate that both Candidate and Authorisation listing may have a sizeable effect on the use of SVHCs. It would be desirable to expand similar investigations to other EU Member States where data are available.

1. Introduction

The REACH Authorisation process aims to ensure that substances of very high concern (SVHCs) are progressively replaced by less hazardous substances or technologies where these are technically feasible and economically viable.

Up until now, conclusions on whether the system achieves this goal have been based on observational studies. In this report, a causal approach is proposed to estimate the effects of regulatory decisions such as adding a substance to the Candidate List (i.e. identifying it as an SVHC) or promoting a substance to the Authorisation List (i.e. adding it to Annex XIV to REACH) on SVHC use in the EU. Such an approach requires information on the regulated substances and on similar substances that were not or differently regulated.

In what follows, two case studies are presented that seek to quantify the causal effects that regulatory actions under the REACH Authorisation title have had on the use of specific SVHCs in the EU/EEA.[1] The report first presents a summary of the Authorisation system and its current implementation. Next, the objectives and premises of causal analysis are summarised. Finally, two case studies are presented that look at two distinct policy evaluation metrics—production and emission volumes of SVHCs. These metrics have different advantages and disadvantages in terms of interpretability, representability, and generalisability, which will be briefly discussed in the concluding section of the report.

2. Summary of the Authorisation process

2.1. Candidate listing

The REACH Authorisation process is initiated through a proposal by ECHA (at the request of the European Commission) or an EU Member State to identify a substance (group) as an SVHC. Substances with the following hazard properties may be identified as SVHCs:

- meeting the criteria for classification as carcinogenic, mutagenic, or toxic for reproduction (CMR) category 1A or 1B in accordance with the CLP Regulation;
- being persistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB) according to REACH Annex XIII;
- causing an equivalent level of concern as CMR or PBT/vPvB substances.

The SVHC identification process foresees a 45-day consultation during which interested parties may provide information on substance properties, uses and alternatives. Identified substances are included in the Candidate List maintained by ECHA.[2] The inclusion of a substance in this list brings to pass immediate obligations for its suppliers (including the notification of articles containing the substance, provision of safety data sheets to customers, minimisation of exposures and releases).

[1] Earlier studies by the Austrian and Danish competent authorities (Backes, 2017; COWI, 2019) and the European Commission (EFTEC, 2017) looked descriptively at tonnage developments of SVHCs after Candidate/Authorisation listing but did not undertake a statistical analysis as presented here.

[2] As of September 2021, the Candidate List comprised 219 (groups of) substances. Since the last REACH Review report in 2017, 45 (groups of) substances were newly identified as SVHCs.

2.2. Authorisation listing

As a permanent task, ECHA assesses substances on the Candidate List to determine which ones the Commission should promote to the Authorisation List. This prioritisation is based on information on uses and volumes in registration dossiers of the substance but may also consider other information received during the SVHC consultation or other relevant sources. Priority is given to those substances which have dispersive uses, high volumes, or persistent, bioaccumulative and toxic (PBT/vPvB) properties.

Based on the prioritisation, ECHA makes recommendations which establish:

i. a sunset date from which the placing on the market and use of a substance requires an authorisation (unless its use is exempt from the Authorisation requirement);

ii. a latest application date by which an application for continued use of the substance must have been received by ECHA to benefit from transitional arrangements until a decision is made by the European Commission;

iii. review periods for specific uses, if any; and

iv. a list of uses that are exempt from the Authorisation requirement, if any.[3]

Draft recommendations are subject to another consultation and the Member State Committee (MSC) reviews the comments submitted during that consultation when preparing its opinion on the draft recommendations. ECHA considers the MSC opinion before submitting a final recommendation to the European Commission for a decision on the priority substances to be included in the Authorisation List (Annex XIV to REACH). These recommendations are made every two years.

2.3. Applications for authorisation

Firms that intend to continue using a substance included in the Authorisation List after the sunset date need to prepare an application for authorisation (unless their use is exempt). An application for authorisation can be submitted for one or several uses of one or a group of similar substances. Applicants may apply for authorisation of their own use or of uses for which they intend to place the substance on the market.

ECHA recently published a separate study on 'Socio-economic impacts of REACH authorisations' summarising its experiences with applications for authorisation up until now. The report concluded that applying for an authorisation was a costly enterprise—according to an applicant survey the average cost per use applied for is €200 000—which firms would do if switching to alternative substances or technologies was technically or economically not feasible.

This suggests that the authorisation requirement creates an incentive to cease and, where viable, substitute uses of SVHCs in the EU. Indeed, ECHA has not received applications for almost half of the substances currently on the Authorisation List. Moreover, a recent ECHA study on 'Impacts of REACH restriction and authorisation on substitution in the EU' finds

[3] As of September 2021, there are 54 (groups of) substances are on the Authorisation List. Since the last REACH Review report in 2017, 22 (groups of) substances were newly added.

that firms seek to substitute SVHCs before their use becomes subject to authorisation. Based on these reasons, ECHA suspects that the REACH Authorisation title has contributed to reducing the use of SVHCs in the EU.

2.4. Descriptive evidence on the consumption of SVHCs in the EU

One way of studying the impacts the REACH Authorisation system has had on the use of SVHCs is to obtain time series data on the consumption (i.e. production + imports – exports) of these substances in the EU. Unfortunately, for most substances in question, such data are not available on an EU-wide level at the level of detail necessary to undertake a causal analysis. What is available are Prodcom[4] data for specific sectors that use SVHCs. Bear in mind, however, that such data i) is collected at the substance group level and may at times cover both the SVHC in question as well as its closest substitute; and ii) does not differentiate between exempt uses and uses that fall under the Authorisation requirement.

Some insights can still be gained from looking at the consumption of key SVHCs for which sunset dates have recently passed. For example, Figure 1 shows that the consumption of chromium compounds in the EU has drastically fallen over the last decade. As this drop coincides with the entry of chromium trioxide and other hexavalent chromium compounds on the Candidate List in late 2010, it might be tempting to interpret this as an impact of regulation. However, this development might be just as well explained by the Great Recession in late 2009 and the economic downturn in the years thereafter, or a combination of both effects. It is for these reasons that descriptive evidence is of limited help in analysing policy consequences for SVHCs. Instead, policy analysis should be based on robust evidence that considers uncertainties and tries to distil causal effects from the available data (Manski, 2013).

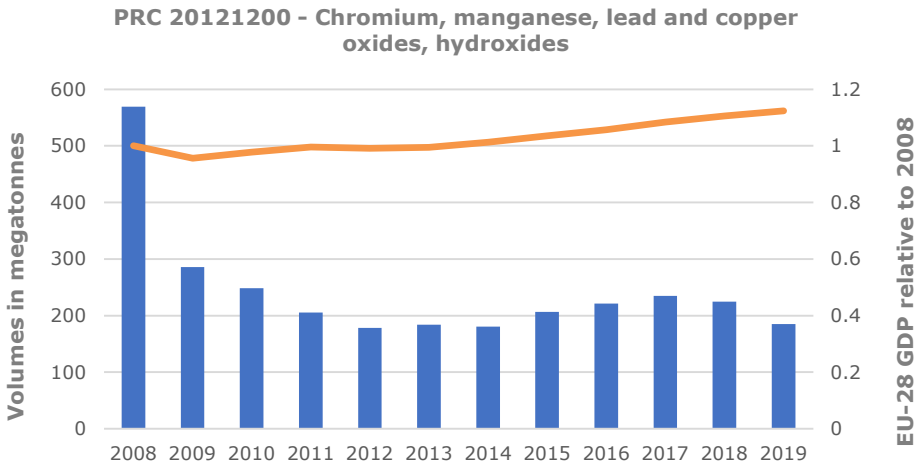

Figure 1. Consumption of PRC 20121200 – Chromium, manganese, lead and copper oxides, hydroxides (source: Prodcom, accessed on 15 September 2021) vs relative EU-28 GDP (source: Eurostat, accessed on 15 September 2021).

[4] According to (EEC) No 3924/91, Member States shall carry out a statistical survey of their industrial production on an annual basis. The resulting Prodcom (from the French '**Prod**uction **com**munautaire') database provides statistics on the production of manufactured goods carried out by enterprises on the national territory of the reporting countries according to sections B and C of the Statistical Classification of Economic Activity in the European Union (NACE 2).

3. Objectives

In the context of the REACH Authorisation system, two relevant policy questions are:

1) Does adding a substance to the Candidate List reduce its use in the EU?
2) Does adding a substance to the Authorisation List reduce its use in the EU?

To answer these questions, the causal relationship between the regulatory action (the so-called 'treatment') and the development of SVHC use needs to be analysed.[5] Importantly, what happened to a regulated substance but also what would have happened if the substance had not been regulated needs to be established. In other words, a counterfactual state of the world needs to be constructed that can then be compared to the actual, observed world. Achieving this goal requires establishing two groups of observations that are similar except for their treatment status (Holland, 1986; Rubin & Imbens, 2015).[6] To ensure similarity, treated and untreated control units must be from the same universe of observations so that any observed difference in outcome can be attributed with high confidence to the treatment.

In practice, it is not always possible to ensure that observations are identical except for their treatment status. Starting from the presumption that the regulator is interested in the effects of regulatory decisions that take place, suitable information to facilitate comparative case studies may still be found. Such studies are a well-established method for estimating the evolution of aggregate outcomes for a unit subject to regulation (e.g. the use of a substance listed in REACH Annex XIV) and compare it to the evolution of other units that were not or differently treated. Abadie et al. (2010) explain that this task is challenging as there is often some degree of ambiguity about how control units are chosen. Indeed, comparative case studies typically rely on comparison groups which may not reproduce the counterfactual outcome trajectory that treated units would have experienced without the regulatory decision of interest. To address this issue, Abadie and others developed and refined a data-driven procedure to construct suitable comparison groups known as 'Synthetic Control Method' or SCM (see Abadie, 2020 for a review).

The basic idea of SCM is that a combination of multiple control units often provides a better comparator than any actual unit. Such a synthetic control unit ***S*** is the weighted average of observed controls that best mimics the pre-treatment outcome of the unit of interest. To fix ideas, consider a substance ***X*** that is listed in Annex XIV in year ***t***. In statistics parlance, ***X*** is called a treated unit. Substances ***Y*** and ***Z*** are not listed in Annex XIV but are on the Candidate List (and otherwise similar to ***X***). They serve as a 'donor pool'. A synthetic control unit will now be constructed as a weighted average of ***Y*** and ***Z***, whereby the weights are chosen in such a way that the synthetic control unit ***S*** will mimic the use of ***X*** in the pre-treatment period, that is before the year ***t***. The causal effect of including the substance on Annex XIV will then be captured by the difference between ***S*** and ***X***.

[5] Causation involves testing the following requirements: i) cause and effect are correlated; ii) cause precedes effect so that the direction of causation is clear; iii) there exists a plausible mechanism that relates cause and effect; iv) other causes can be excluded as determinants of observed effects.

[6] In what follows, regulatory actions will be referred to as 'treatments' or, in the context of multiple substances, as 'treated' units. Substances that are not or differently regulated, i.e. not treated, will be referred to as control units. Together, the control units form a so-called 'donor pool'.

4. Case studies

In this section, two case studies will be analysed that look at reported production, use volumes and emissions of specific SVHCs, respectively. The data for the analysis was manually compiled from different external data sources.

4.1. Case study 1—production of SVHCs in Sweden

Similar to requirements in other Nordic countries, Swedish producers of chemicals of concern are required to annually register their production volumes.[7] For this purpose, the Swedish Chemicals Agency maintains a Products Register in which information is stored on chemical products and biotechnical organisms that are manufactured in, or imported to, Sweden.

For this study, a dataset is analysed that compiles information on 97 substances produced in Sweden during the period 1992-2016. All of the substances are on ChemSec's SIN List[8] and by 2016 all of them were also listed in the Candidate List; 36 of them had been included in the Authorisation List. Figure 2 provides a visual overview. For each of these substances, the dataset contains information about the annual production volume in tonnes, the number of products the substance is used in, and a set of the intrinsic hazard properties for which the substance was listed in accordance with Article 57 of REACH.

Based on the dataset, whether moving a substance from the Candidate List to the Authorisation List had a discernible effect on its production volume can be analysed. Figure 3 provides a visual comparison, displaying the time trends for log-transformed production volumes of treated (i.e. Authorisation listed) units and control (i.e. Candidate listed) units. From this comparison, a clear difference cannot be detected in terms of initial volumes, suggesting that Candidate-listed substances provide a decent donor pool for constructing a synthetic control that mimics the average development of the treated units.[9] This, in turn, will facilitate the estimation of the average causal effect of the treatment on the treated units (ATT) in a panel data setting, where i) some units are exposed to a binary treatment during some periods, and ii) synthetic controls are imputed using weighted average outcomes with weights chosen in such a way that the weighted outcomes for control units match the outcomes for treated units in the pre-treatment period.

While this may sound complex, the actual idea is quite intuitive: if an appropriate combination of control units to mimic the pre-treatment path of the treated units is found, then this gives a valid comparator that allows the ATT to be estimated.[10] The discussion presented below follows the practical guidance given in Liu et al. (2021).

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[7] Similar requirements exist in Denmark, Finland and Norway, see: http://spin2000.net/.

[8] The non-profit ChemSec maintains a SIN ("Substitute It Now") List of chemicals of concern that are used in a wide variety of articles, products, and manufacturing processes.

[9] As discussed by Abadie (2020), the literature on synthetic controls and related methods is rapidly expanding. One recent advancement concerns the estimation and inference with synthetic controls for situations with multiple treated units. A popular approach which is also pursued for this case study is to construct a single synthetic control to match the aggregate values of treated units.

[10] Estimations in this section rely on the matrix completion method introduced by Athey et al. (2021) as implemented in the R package `fect` downloadable under http://yiqingxu.org/software.html.

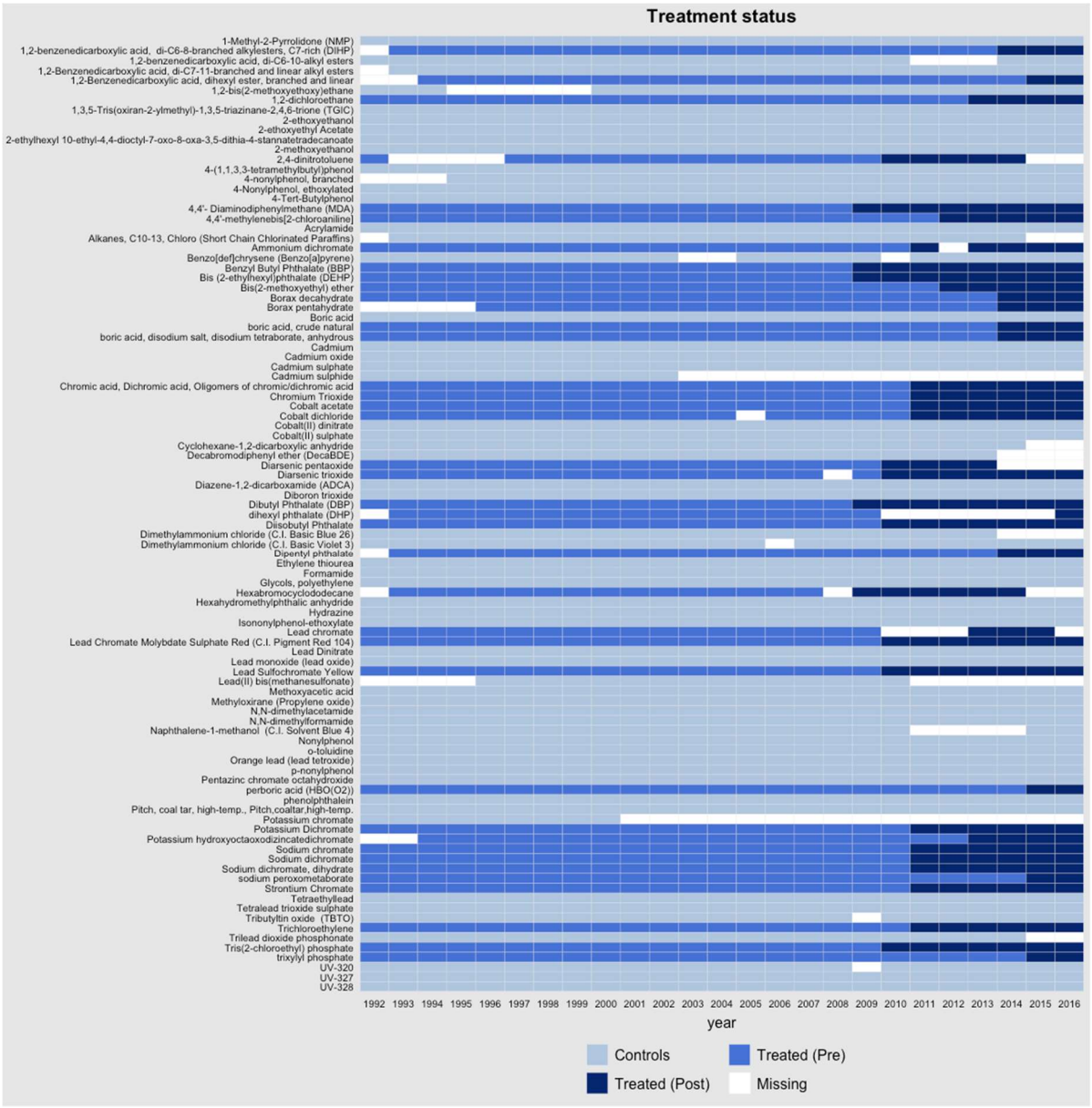


Figure 2. Overview of SVHCs on the Authorisation List (treated) and on the Candidate List (controls) in the Swedish dataset. 'Treated (Pre)' and 'Treated (Post)' refer to the periods before and after inclusion in the Authorisation List, respectively.

Panel A of Figure 4 visualises the estimated ATT per period. The ATT averaged over all periods can be reported in two different ways by weighing either each treated observation or each treated unit equally. The latter measure accounts for the difference in treatment date (i.e. the different years in which substances moved from the Candidate List to the Authorisation List) and is, consequently, better suited for the goal of this analysis. The ATT averaged over treated units amounts to –0.528 (p-value = 0.042), suggesting that volumes dropped by 41 % on average because of the Authorisation requirements.[11] This is a sizable and statistically significant effect (the 90 % confidence interval around the ATT estimate implies a reduction between 3 % and 64 %).

[11] The estimated ATT is of the form E(log(volume)|treated) – E(log(volume)|untreated). Applying simple algebra, the percentage reduction can be calculated as 1 – exp(–0.528) = 0.410.

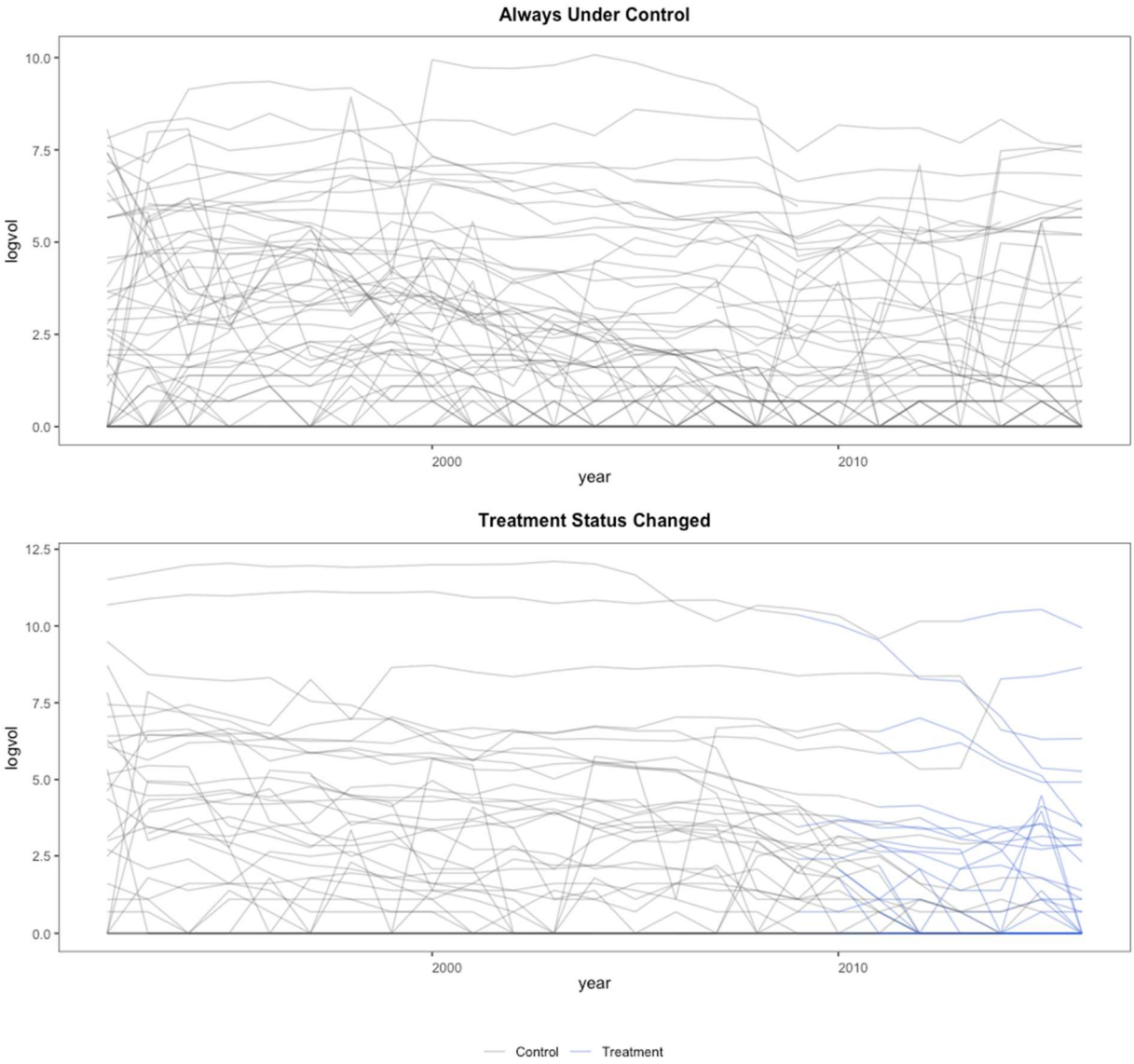


Figure 3. Development of production volumes of control (upper panel) and treated (lower panel) units over time. Blue lines in the lower panel indicate treatment.

An important identification assumption made to estimate the ATT is that of parallel trends, i.e. trends in pre-treatment outcomes should be the same although treated and control units may have different levels of outcome before the treatment (Rubin & Imbens, 2015).[12] Liu et al. (2021) propose a suite of visual and diagnostic tests to ensure the parallel trends assumption holds. The first and most intuitive test is a visual plot of the dynamic treatment effect. As can be seen from Panel A of Figure 4, there is no detectable trend towards the onset of treatment and ATT estimates in the pre-treatment periods are all close to zero as would be expected under the parallel trends assumption.

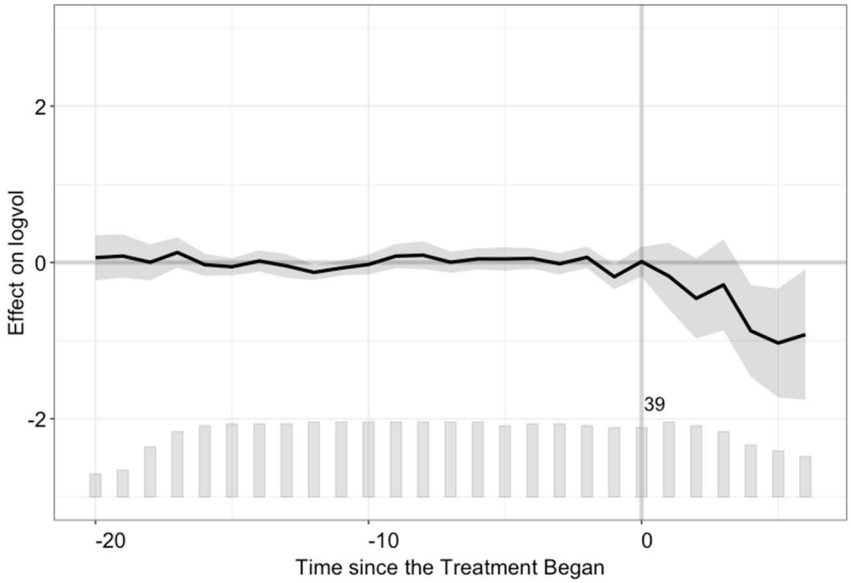
Second, a formal 'equivalence' test can be conducted to see whether there are trends before treatment onset. Panel B of Figure 4 visualises this test, showing that the trend line hovers around zero and does not pass the confidence area indicated by the dashed red

[12] Indeed, production volumes may be in the order of megatons for some SVHCs and in the order of kilograms for others.

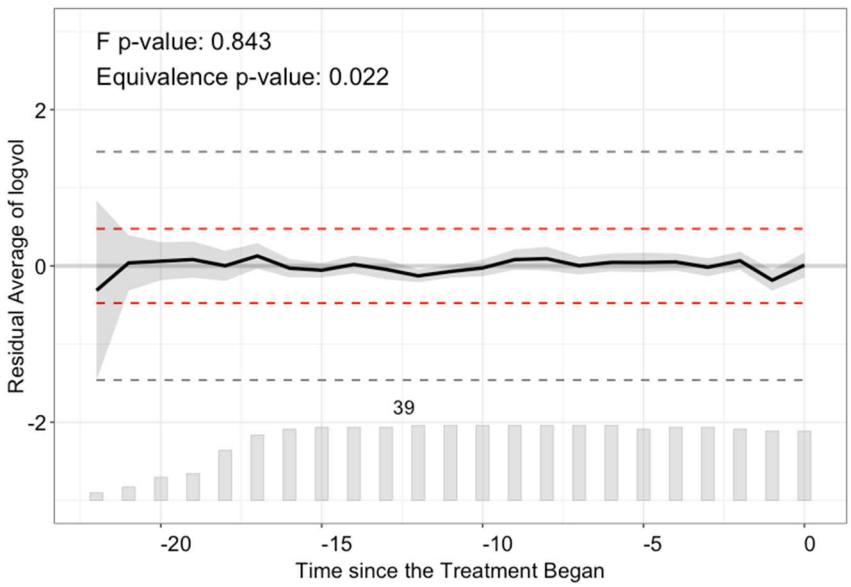
lines. This lends further support to the assumption that there are no time-varying confounders at play.

A placebo test serves as a third piece of evidence. This test permutates the data to see what would have happened if treatment onset for each treated unit had been earlier than it actually was, and then applies the same estimation strategy to these counterfactual data. If the counterfactual ATT estimate is statistically different from zero, this is evidence against the no-time-varying-confounder condition of the parallel trends assumption. Following the advice in Liu et al. (2021), the advancement of treatment onset is set to three periods. Panel C of Figure 4 highlights the periods serving as placebo in blue. The test statistics indicate that the null hypothesis that the placebo effect is zero (*p*-value=0.841) cannot be rejected and that the null hypothesis that the placebo effect is larger than the true ATT (*p*-value=0.000) can be rejected. As such, a conclusion can be drawn that the placebo test, together with the pre-trend test, justifies the identifying parallel trends assumption.

Panel A



Panel B



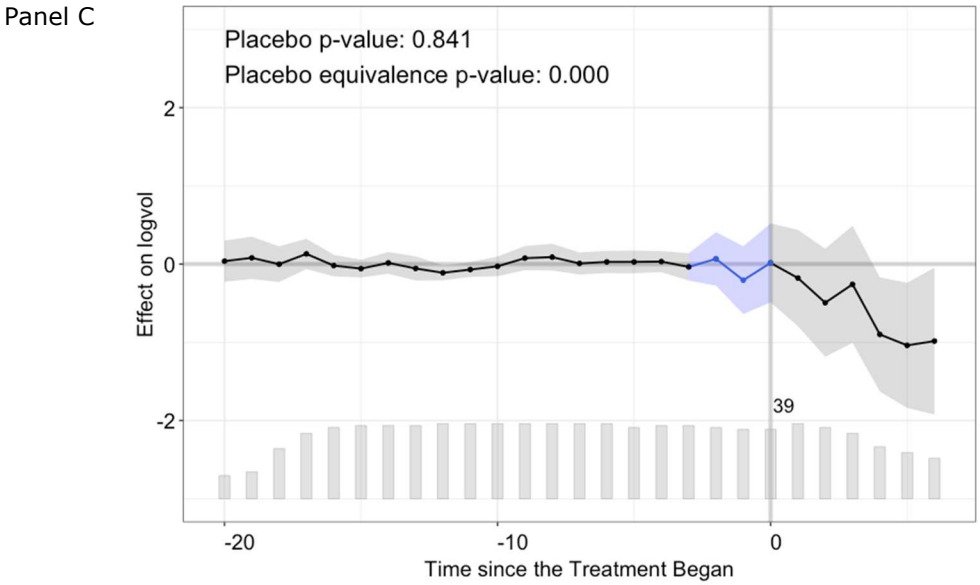


Figure 4. Dynamic treatment effect (Panel A), pre-trend test (Panel B), and placebo test (Panel C) for the Swedish dataset.

4.2. Case study 2—emission of SVHCs in the E-PRTR

The European Pollutant Release and Transfer Register (E-PRTR) is a Europe-wide register of environmental release data from industrial facilities in EU/EEA Member States established under Regulation (EC) No 166/2006. It contains data reported annually from 2007 onwards by some 30 000 industrial facilities covering 65 economic activities across Europe, including information concerning the amounts of pollutant releases to air, water, and land as well as off-site transfers of waste and pollutants in wastewater. Release and transfer data are reported on 91 key pollutants (set in Annex II to Regulation (EC) No 166/2006) including heavy metals, pesticides, greenhouse gases, and organic chemicals of which several correspond to substances that have been added to the Candidate List and some are on the Authorisation List. Industrial facilities that undertake one or more of the activities specified in Annex I to Regulation (EC) No 166/2006 must annually report release and transfer data (unless they stay below the capacity thresholds).

In this case study, data on releases of chlorinated organic and other organic substances reported by facilities in the EU/EEA for the period 2007-2017 is analysed. Some remarks about data quality are warranted. A look at the raw release data suggests partially erratic reporting at facility level, resulting in differences between Member States, sectors and years that may not reflect actual changes in pollutant releases. Moreover, care should be taken when considering releases to water by wastewater treatment plants (WWTPs) as these may lead to double counting of transfers destined for wastewater treatment (WWT) by industrial facilities.[13] Finally, some of the pollutants may have been subject to other regulations than REACH. Any such additional regulatory impact has been ignored in the data analysis presented below, but the possibility of such impacts should be kept in mind.

[13] Double counting here means that pollutant quantities reported by industrial facilities as transfers destined for WWT may be captured again in the pollutant quantities reported by WWTPs as releases to water.

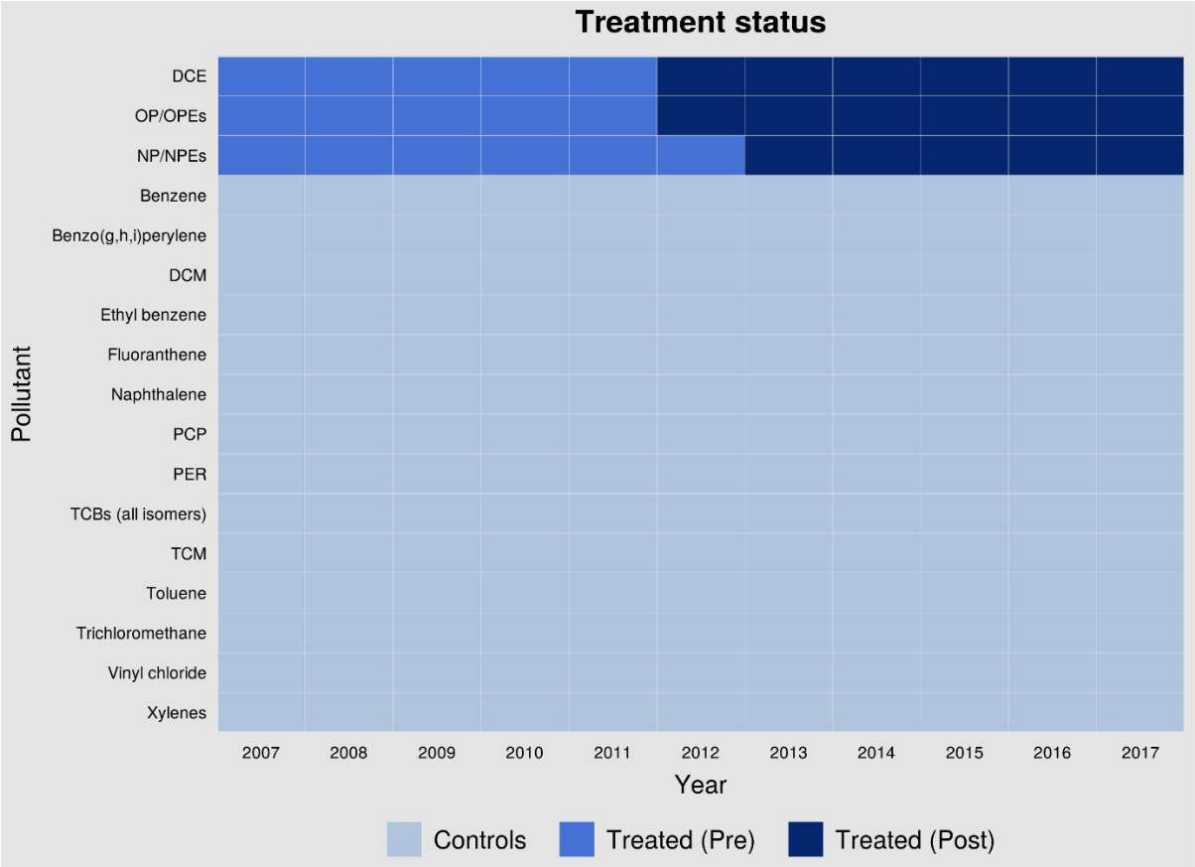


Figure 5. Overview of substances used as treated units (on Candidate List) and control units (not on Candidate List) in the E-PRTR data analysis. 'Treated (Pre)' and 'Treated (Post)' refer to the periods before and after inclusion in the Candidate List, respectively.

The analysis presented below, therefore, excludes data reported by WWTPs and focuses on pollutant quantities reported as releases to water or transfers destined for WWT for those substances for which at least five facilities had reported and for which five years of pre-treatment data was available, where treatment now means inclusion in the Candidate List. These exclusion criteria resulted in a relatively small data pool with 1,2-dichloroethane (DCE, also known as EDC), octylphenol/octylphenol ethoxylates (OP/OPEs) and nonylphenol/nonylphenol ethoxylates (NP/NPEs) as treated units, and 14 substances as control units (Figure 5).

As the pool of substances is quite diverse, so are the releases reported. Figure 6 illustrates that they vary from less than a tonne to several hundred tonnes per year. As this large variation is impeding the construction of a synthetic control (Abadie, 2020), the pollutant quantity was log transformed making them more comparable to each other.[14] Analyses were then run separately for DCE, OP/OPEs and NP/NPEs as treated units.[15] All pre-treatment lags of the outcome variable but no other covariates were included in the analysis.

[14] Recall that small changes in the natural logarithm are almost equal to percentage changes in the original data. This is a convenient assumption if it is assumed that substances are used in differently sized markets that are all subject to global economic fluctuations.

[15] Estimations were done with the `Synth` package in R (v. 4.01).

In Table 1, the constructed synthetic controls are compared to the observed treatment units and to a crude average of control units for the pre-treatment period. The comparison suggests that for both DCE and NP/NPEs, the synthetic controls are accurately approximating the observed units in the pre-treatment period, whereas this is not the case for OP/OPEs suggesting that the analysis may not be reliably measuring causal effects. Below, the analysis for each of the three treated substances is presented separately.

DCE. To start with, consider the trajectories of DCE and its synthetic control unit. As can be seen from Figure 7, in the pre-treatment period the synthetic control unit mimics the log releases of DCE accurately through a weighted combination of the releases reported for five control units (with weights given in brackets): benzene (33.3 %), benzo(g,h,i)perylene (27.8 %), tetrachloroethylene (16.5 %), trichlorobenzenes (11.9 %), and fluoranthene (10.5 %). In the year before the treatment date, the two trajectories start to diverge. While the synthetic control unit displays constant releases, the observed releases drop off sharply, hinting at a significant cut back in substance use *because* of Candidate listing. Indeed, Figure 8 displays the average treatment effect on the treated unit, suggesting that releases had declined by about 66 % over the period 2011-2017. Figure 8 also illustrates a placebo test with permutations that confirm the robustness of the analysis (Abadie, 2020). Taken together, this suggests that Candidate listing had a sizeable impact on the releases of DCE as reported under the E-PRTR requirements. It seems plausible to attribute this cutback to reductions in the use of the substance that firms made in response to the Candidate listing (and the threat of Authorisation listing).

OP/OPEs. Consider the trajectories of OP/OPEs and its synthetic control unit displayed in Figure 9. As can be seen, the synthetic control unit fails to accurately mimic the log releases of OP/OPEs in the pre-treatment period. A look at the composition of the synthetic control unit indicates that it is composed of only two control units (with weights given in brackets): dichloromethane (70.7 %), and pentachlorophenol (29.3 %). Together with the trajectory plot, this suggests the donor pool is not suited to mimic the erratic year-to-year development of reported OP/OPEs releases (Figure 6). While this suggests the size of the average treatment effect plotted in Figure 10 is unreliable, a sharp decline in 2014 releases should be noted. However, the analysis undertaken here cannot establish a causal relationship between this decline and the Candidate listing.

NP/NPEs. Figure 11 displays the trajectories of NP/NPEs and its synthetic control unit suggesting that the synthetic control unit mimics the log releases of NP/NPEs in the pre-treatment period relatively accurately. The synthetic control unit is composed of four control units (with weights given in brackets): benzo(g,h,i)perylene (42.5 %), benzene (34.8 %), tetrachloroethylene (12.5 %), and trichlorobenzenes (9.7 %). Two years after treatment onset, the two trajectories start to diverge. While the synthetic control unit hints at constant releases, the observed releases drop off sharply. However, since this is a delayed effect, it is difficult to say whether Candidate listing is the cause for the drop. Figure 12 displays the average treatment effect on the treated unit, suggesting that releases had declined by about 74 % over the period 2015-2017. Again, Figure 12 illustrates a placebo test, but differently to DCE, this test does not support the robustness of the analysis. Therefore, the interpretation of the estimated decline in emissions warrants some caution and the effect should not be interpreted as the causal effect of Candidate listing.

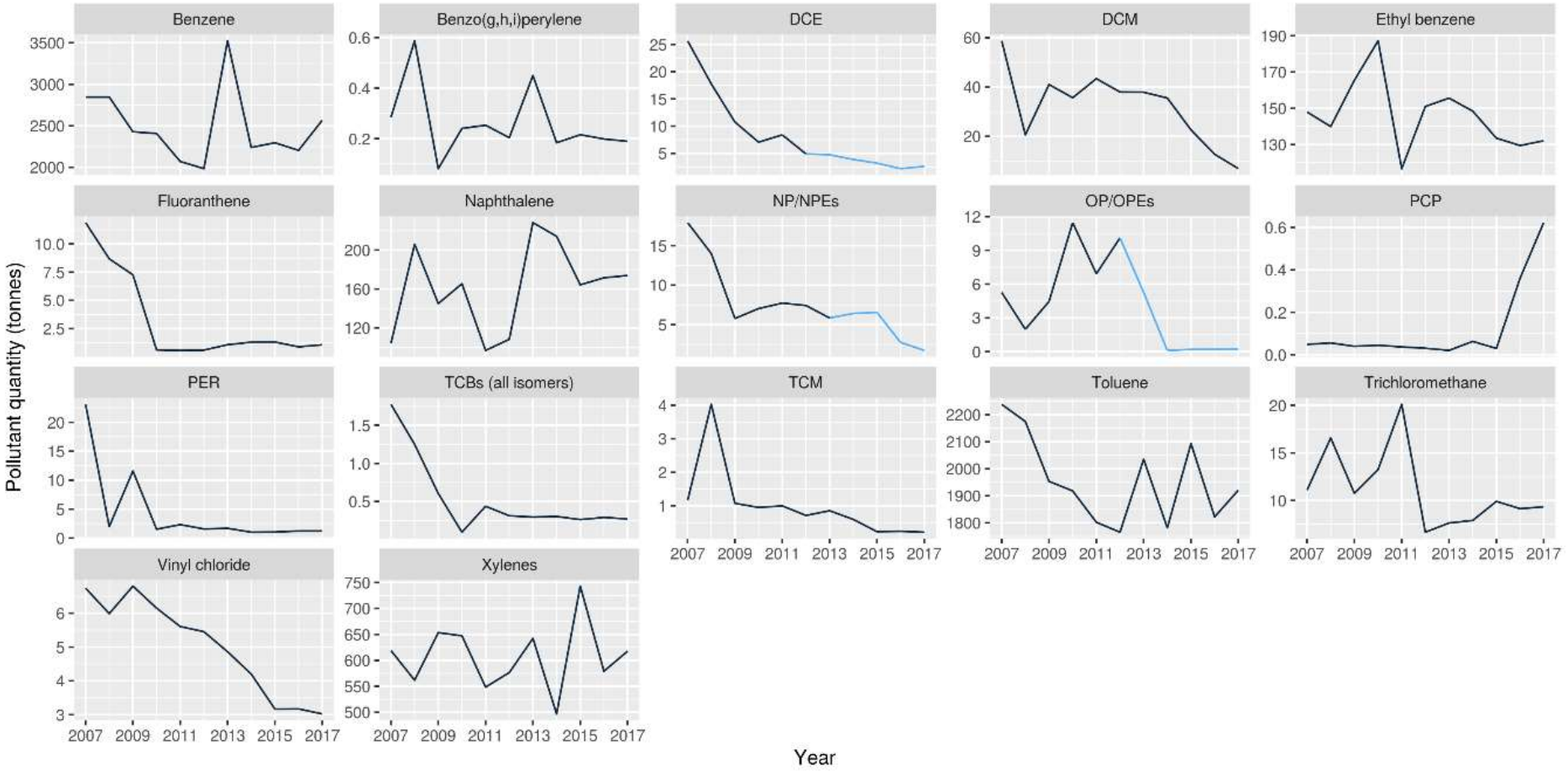


Figure 6. Development of releases of treated and control units over time.

Table 1. Approximation of treated units by synthetic control units and averages of control units.

Variable	Treated unit	Synthetic control unit	Average of control units
DCE			
Log(Pollutant quantity 2007)	10.153	10.056	9.921
Log(Pollutant quantity 2008)	9.785	9.778	9.829
Log(Pollutant quantity 2009)	9.282	9.362	9.636
Log(Pollutant quantity 2010)	8.861	8.849	9.275
Log(Pollutant quantity 2011)	9.035	9.054	9.339
OP/OPEs			
Log(Pollutant quantity 2007)	8.566	8.901	9.921
Log(Pollutant quantity 2008)	7.596	8.199	9.829
Log(Pollutant quantity 2009)	8.402	8.585	9.636
Log(Pollutant quantity 2010)	9.347	8.521	9.275
Log(Pollutant quantity 2011)	8.843	8.604	9.339
NP/NPEs[1]			
Log(Pollutant quantity 2007)	9.793	9.607	9.921
Log(Pollutant quantity 2008)	9.547	9.572	9.829
Log(Pollutant quantity 2009)	8.662	8.829	9.636
Log(Pollutant quantity 2010)	8.859	8.851	9.275
Log(Pollutant quantity 2011)	8.953	9.019	9.339
Log(Pollutant quantity 2012)	8.913	8.831	9.171

[1)] For NP/NPEs, there is one year more because Candidate listing for this substance took place later.

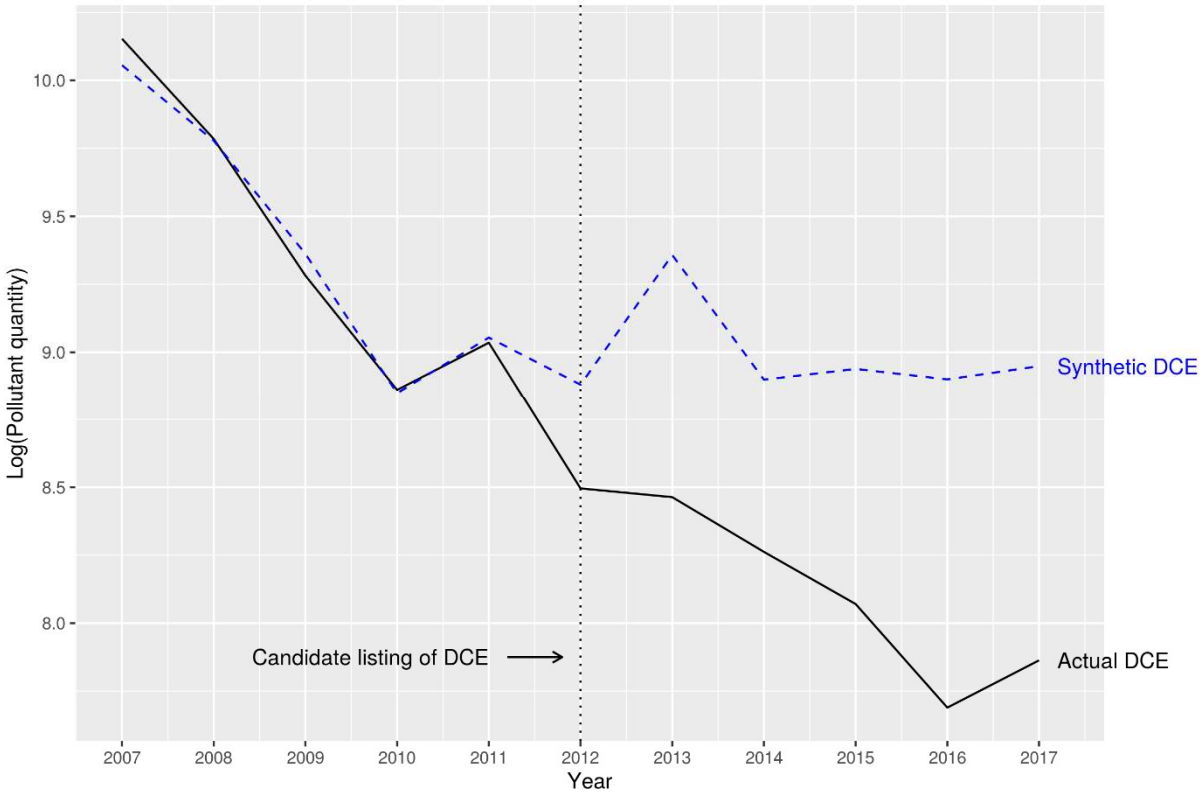


Figure 7. Trajectory of DCE releases and its synthetic control unit.

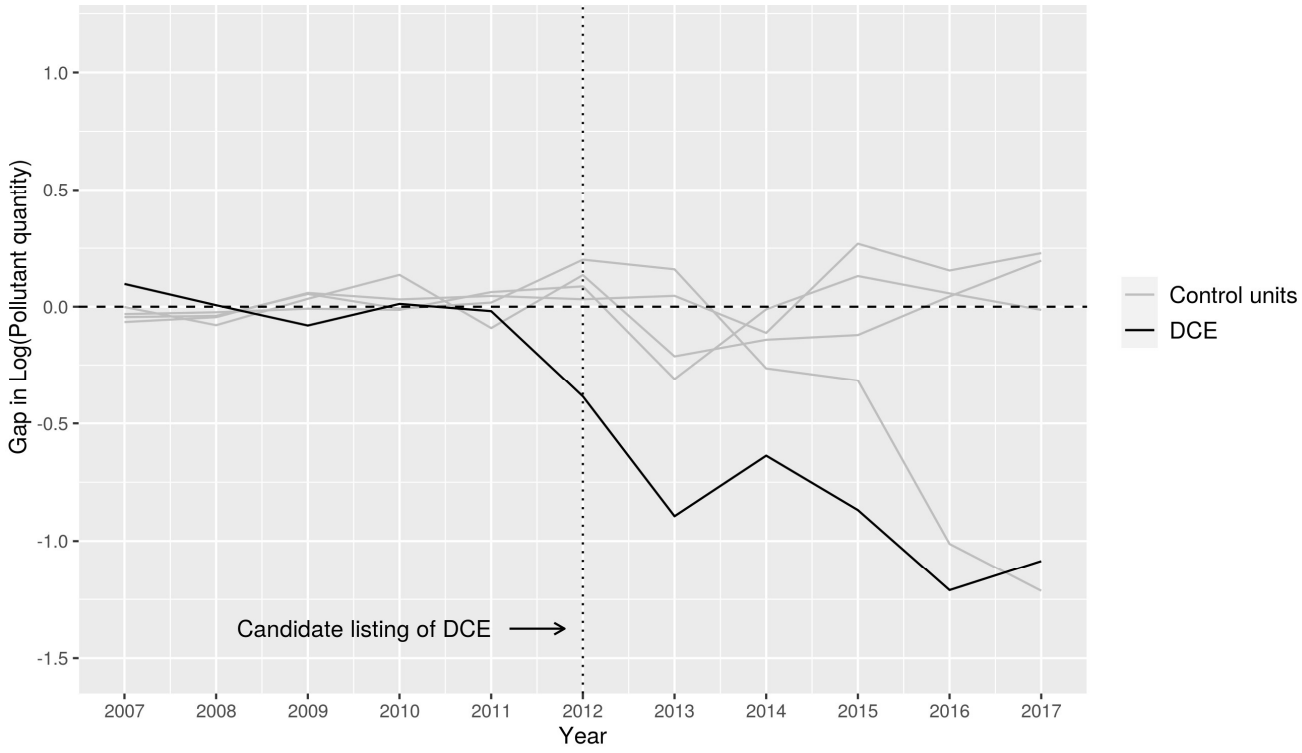


Figure 8. Average treatment effect on DCE.

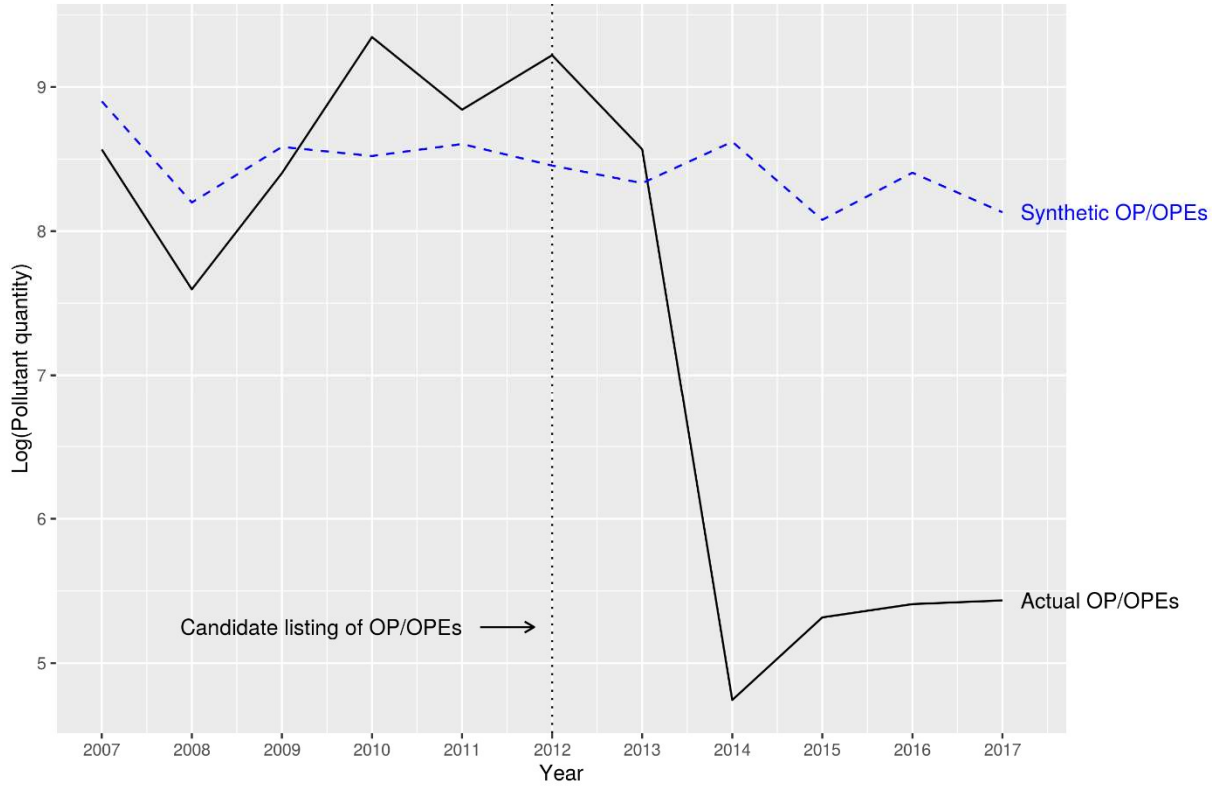


Figure 9. Trajectory of OP/OPEs releases and its synthetic control unit.

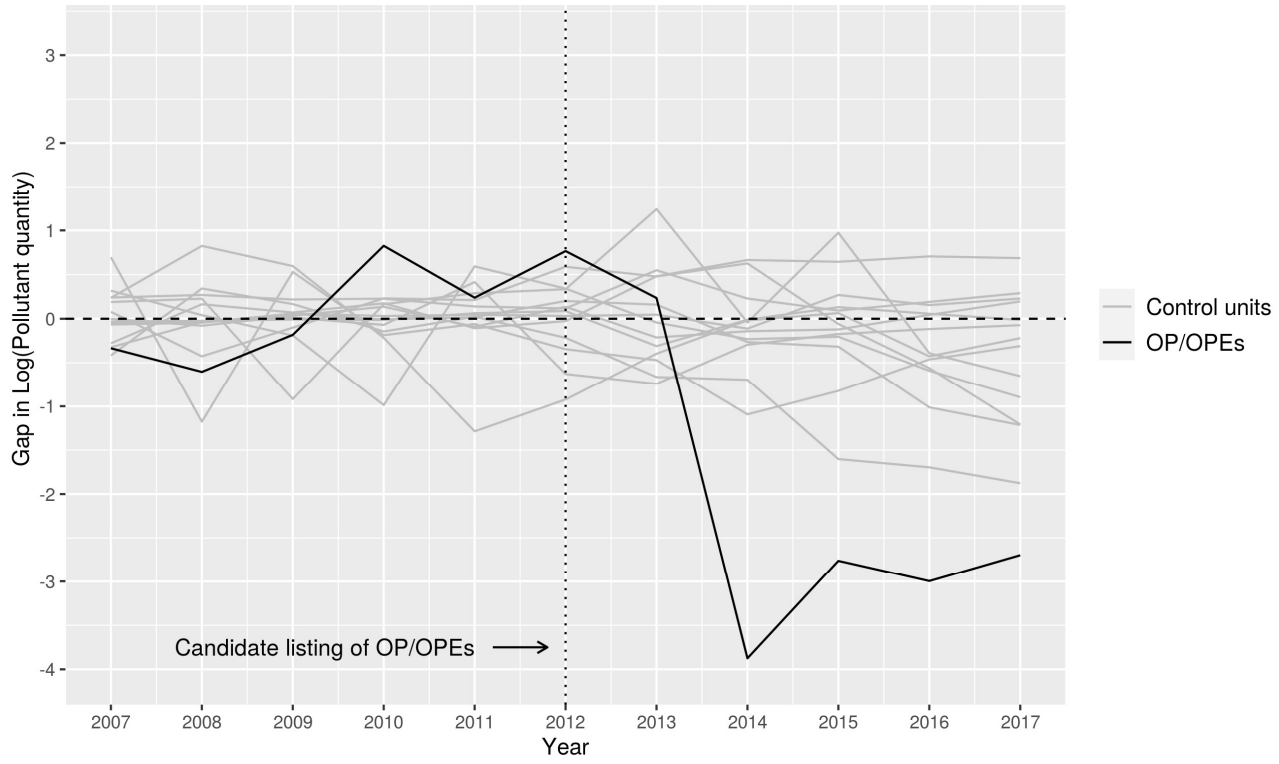


Figure 10. Average treatment effect on OP/OPEs.

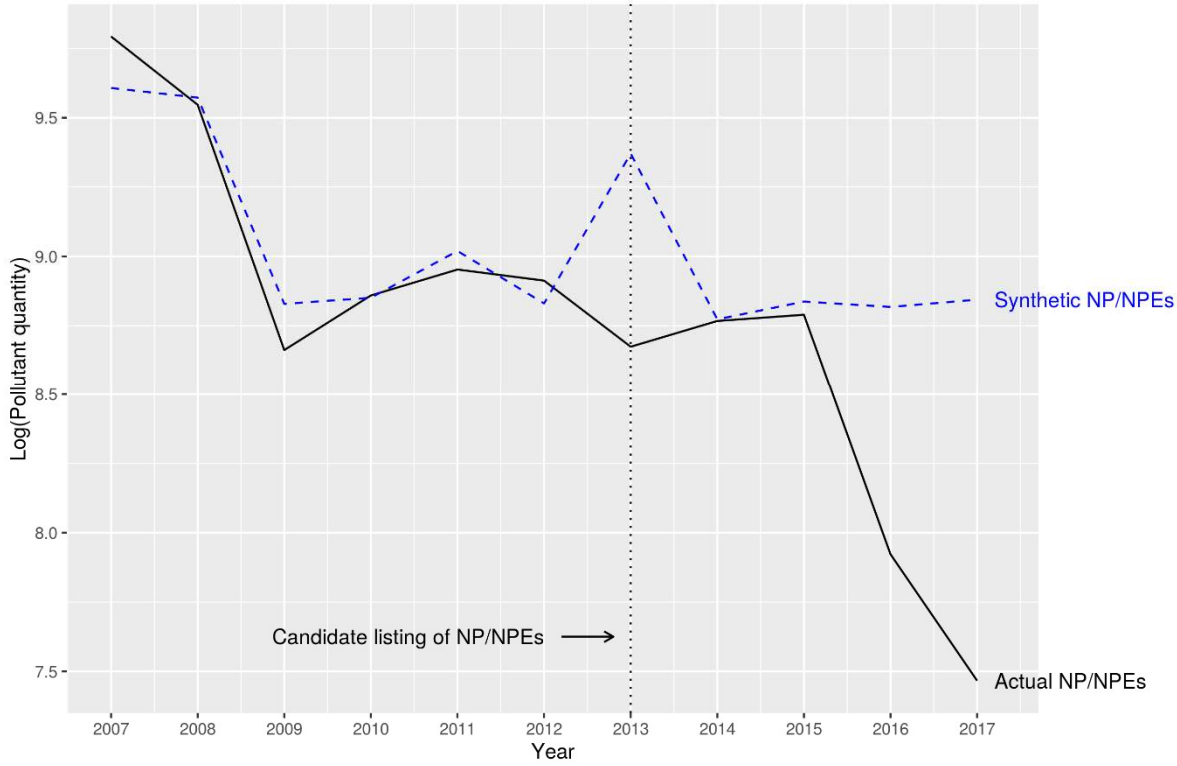


Figure 11. Trajectory of NP/NPEs releases and its synthetic control unit.

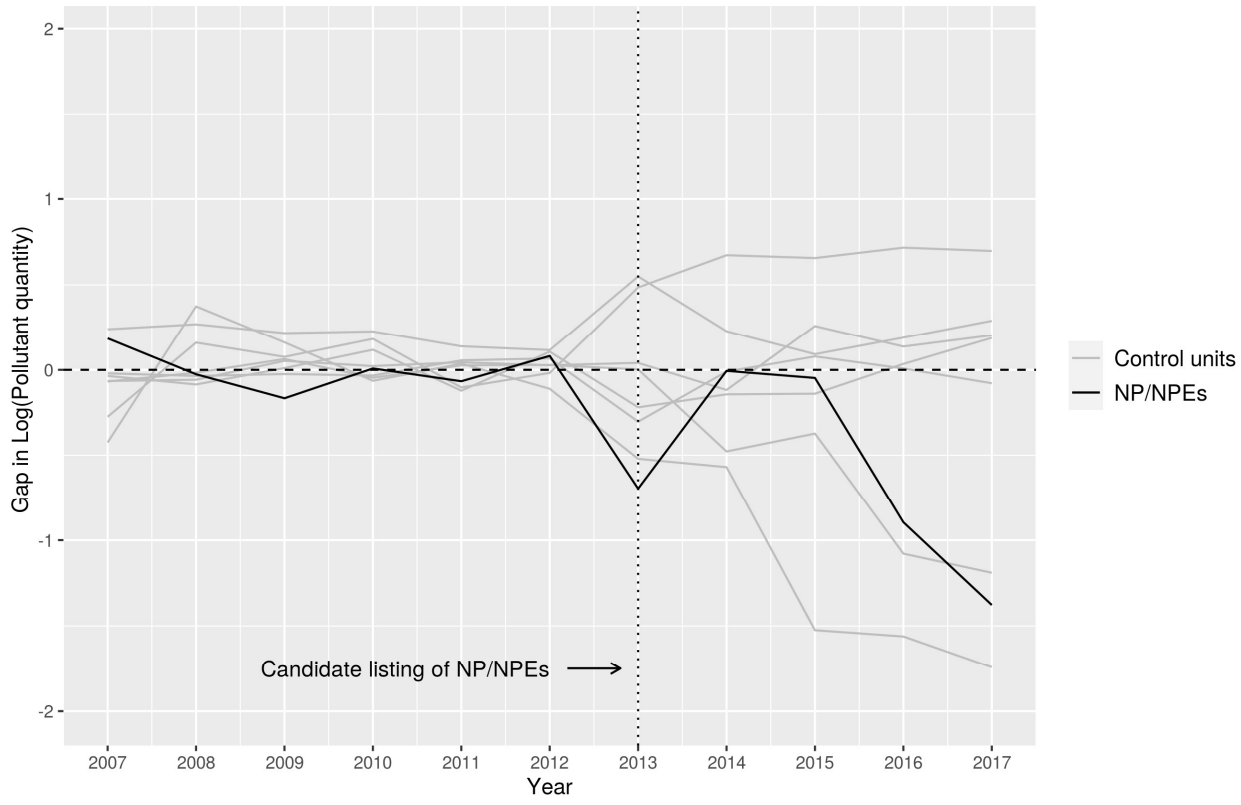


Figure 12. Average treatment effect on NP/NPEs.

5. Conclusions

How well is the REACH Authorisation process achieving the goal of substituting SVHCs? This question has been intensely debated with many opinions formed on perceptions rather than empirical evidence. In this report, an attempt is made to address the question in an evidence-based manner. To this effect, two case studies are presented that seek to estimate the causal effect of regulatory actions under the REACH Authorisation title on the use in production and the emission volumes of SVHCs, respectively.

The first case study presents robust evidence that five years after a substance entered Annex XIV, the average annual SVHC use of Swedish firms dropped by about 40 %. This is a strong finding which suggests that the inclusion of a substance in the Authorisation List has a sizeable substitution effect in Sweden. However, it is unclear in how far this finding can be generalised to other EU Member States. Indeed, while Swedish producers have cutback the use of SVHCs, Swedish consumers may still have bought goods that contain or were produced with the help of SVHCs from outside Sweden. Panel data similar to that reported by Swedish firms would be needed to see whether the substitution effect found in this case study is a general response to the Authorisation listing.

The findings of the second case study are less robust due to reporting issues within the European Pollutant Release and Transfer Register. For three SVHCs (DCE, OP/OPEs, NP/NPEs) that were included in the Candidate List and subsequently in the Authorisation List of REACH because of their hazard properties, different pictures emerge. The most robust effect is found for DCE, for which an emission reduction of 66 % following the inclusion of the substance in the Candidate List is estimated. Based on the analysis conducted, it seems plausible to attribute this cutback to reductions in the use of the substance that firms made in response to the listing (and the prospect of inclusion in the Authorisation List). For the OP/OPEs and NP/NPEs, however, the analysis is not robust enough to report a causal effect with any degree of confidence.

The case studies presented in this report rely on very different data sources (data for one country vs EU-wide data, relatively short pre-treatment periods vs long pre-treatment periods) and evaluation metrics (use in production vs emissions, effects on Candidate-listed substances vs effects on Authorisation-listed substances). The results obtained from the case studies have therefore different advantages and disadvantages in terms of the interpretability, representability, and generalisability. What is more important though is that both case studies highlight the importance of accurate, complete, and frequently updated data for any meaningful analysis of the effects of chemicals regulation to be undertaken.

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