Third Party Certification and the Effectiveness of Voluntary Pollution Abatement Programs: Evidence from Responsible Care

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1. Introduction

Industry self-regulation via voluntary pollution abatement has become popular not only with industry groups but also with environmental policy-makers because it gives them a relatively easy to use lever that does not require an act of Congress. There is a substantial academic debate on the effectiveness of such programs, with some authors arguing that these programs are quite effective in reducing pollution (for example, Khanna and Damon 1999 and Bi and Khanna 2012) while others argue, and with equal conviction, that these programs are ineffective at best (Gamper-Rabindran 2006, Vidovic and Khanna 2007, 2012) and counter-productive at worst (King and Lennox 2000, Gamper-Rabindran and Finger 2013). The Achilles heel of this debate as it relates to the United States is that it relies on relatively old data from the 1990s and on programs that are either no longer in existence (for example, the 33/50 Program which ended in 1995) or on early versions of programs that were changed substantively in later years (for example, the American Chemistry Council's Responsible Care, RC, program has been analyzed only through 2001, after which major structural changes were incorporated).

We update the literature on the effectiveness of voluntary pollution abatement in the United States. We use the structural changes in the RC program to ask whether the introduction of independent third party certification from 2005 onwards has yielded lower emissions from RC plants compared to statistically equivalent non-RC plants in the US chemical industry. Our identification strategy relies on the fact that independent third party certification was made mandatory from 2005 onwards. We use a standard difference-in-difference approach to estimate the average treatment effect of third party certification by comparing RC plants before and after third party certification was introduced to other plants in the US chemical industry between 1995 and 2010 who were not remembers of RC and were therefore not subject to the requirement of third party certification.

In addition, we also explore plant-level heterogeneity in the treatment effect using a semi-parametric model. The advantage of this model is that we can identify heterogeneity in the effect of treatment across plants without imposing *a priori* an ad hoc parametric specification of heterogeneity (see Gamper-Rabindran and Finger 2013 for a parametric example), and so serves as a robustness check of our parametric difference-in-difference model. In addition, we use the semi-parametric model to determine if there are certain types of plants in the chemical industry for which third party certification has been more or less effective, or to the degree to which third party certification was effective across plants.

Preliminary results reveal a statistically significant negative average treatment effect. That is, the introduction of third party certification led to a decline in emissions from RC plants compared to other chemical plants that were not a part of RC. Nonetheless, two points are worth noting that temper this result. First, emissions from RC plants are always statistically higher than emissions from non-RC plants, confirming Gamper-Rabindran and Finger's (2013) result for the early years of RC. Second, while the emissions from both RC and non-RC plants are declining over the time period we study, the introduction of third party certification in 2005 did not result in a statistical change in the decline rate of emissions from RC plants compared to non-RC plants.

2. Self-regulation and third party certification

Over the past three decades, voluntary approaches to environmental management have become equally popular among environmental policymakers, industry groups and non-governmental organizations. The U.S. E.P.A's Partnership Programs website alone lists over 40 programs with more than 13,000 participants (http://www.epa.gov/partners/programs/index.htm). The growing reliance on self-regulatory approaches to environmental protection begs the question whether voluntary programs are able to elicit meaningful changes in environmental performance and whether the signals they send accurately reflect the behavior of their participants. Prior research evaluating the effectiveness of voluntary pollution abatement programs found that participation in such programs was either not associated with promoting superior environmental performance among their participants (Rivera, de Leon and Koerber 2006; Gamper-Rabindran 2006; Vidovic and Khanna 2007, 2012) or has actually led to worse environmental outcomes (King and Lennox 2000, Gamper-Rabindran and Finger 2013). On the other hand, Khanna and Damon (1999), Innes and Sam (2008), Sam et al. (2009), Bui and Kapon (2012) and Bi and Khanna (2012) argue that such programs are quite effective in reducing pollution. Some authors have begun to caution that program design characteristics and lack of performance requirements may be responsible for the failure of voluntary approaches to make a difference (Darnall and Carmin 2005; Potoski and Prakash 2005; Rivera, deLeon and Koerber 2006). Weak performance standards and the absence of effective enforcement can permit firms to free ride and continue to serve their own interests at the expense of other participants and the consumers.

The evidence regarding the ineffectiveness of US voluntary programs in achieving environmental protection primarily rests on the evaluations of the 33/50 Program (Gamper-Rabindran 2006, Vidovic and Khanna 2007, 2012), the Sustainable Slopes program (Rivera, de Leon and Koerber 2006) and the early years of the RC program (King and Lennox 2000, Gamper-Rabindran and Finger 2013); all are programs that relied on self-monitoring and assurance from participants that they adhered to the program requirements. It is not clear whether the participants failed to adopt superior environmental protection practices or the program failed to elicit improvement among the participants. At least in the case of RC, King and Lenox (2000) argue that voluntary programs designed by industry associations lack appropriate implementation, monitoring, and reporting procedures that would initiate superior environmental performance by participants.

Among the voluntary programs that award a label or recognition if certain standards are met, third-party oversight has emerged as a way of providing credibility to the certification system. For example, to ensure integrity and sustainability, the EPA integrated third party verification in its Water Sense and the Energy Star programs. The forest product label from the Forest Stewardship Council and the sustainable seafood label from the Marine Stewardship Council use third party verification to award certification to sustainable management of forests and fisheries. Similarly, third party audits of the ISO 9000 Quality Management System Standard and ISO 14001 Environmental Management System Standard were instituted by the International Organization for Standardization. Recently, the American Chemistry Council (ACC) incorporated third party certification in its signature RC program.

The studies that analyze whether third party certification improves environmental performance via voluntary approaches are mainly focused on one program, ISO 14001 certification system. Several early studies found that ISO 14001 certified firms reduced waste and use of resources significantly more than non-registrants (Rao and Hammer 1999; Montabon et al. 2000; Melnyk et al. 2002). Unfortunately these studies suffer from some methodological and sample issues and the results should be interpreted with caution.[1] King et al. (2005) found a

[1] For example, the data used by Rao and Hamner (1999) is based on information collected from a questionnaire administered to ISO 14001 registrants and there is no information on non-registrants in their dataset. In Montabon *et al.* (2000) and Melnyk *et al.* (2002) both independent and dependent variables are constructed from answers to a survey where the respondents were likely the same people who made decisions regarding their firm's participation in

weak negative effect of ISO 14001 on emissions improvement; certification provides stakeholders mainly with information about the ongoing efforts to improve the performance of an environmental management system but it is not correlated with reductions in emissions. Russo (2009) found that being an early adopter is associated with lower emissions and that emissions fall the longer a facility operates under ISO 14001certification. The two most systematic studies that compare the environmental performance of adopters and non-adopters over time are Potoski and Prakash (2005) and Toffel (2006). Both studies, using different methodologies for comparing adopters to non-adopters, found that ISO 14001 certified facilities reduced their pollution emissions more than non-certified facilities. Based on their findings, the authors suggest that programs whose enforcement mechanisms are based on third-party audits could potentially improve compliance with underlying program commitments even in absence of public disclosure of the audit information.

We add to the existing literature on the effectiveness of voluntary management programs by examining whether the introduction of independent third party certification from 2005 onwards yielded lower emissions from RC plants compared to statistically equivalent non-RC plants in the US chemical industry. The advantage of studying the RC program in this context is that the mandatory certification under RC was modeled on the certification under ISO 14001. Our analysis sheds light on whether third party oversight of voluntary abatement programs makes them a more effective instrument in the US policymaker's environmental toolbox.

3. The potential of Responsible Care to improve environmental outcomes

In 1988, the ACC (then known as the Chemical Manufacturers' Association) adopted the

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the ISO 14001 and provided opinions on its impact on the firm's performance.

RC initiative to promote continuous Environmental, Health, Safety and Security (EHS&S) performance improvement for all of its members. The industry association implemented the program in order to improve public perception about the safety of the chemical industry and in anticipation of more stringent regulatory interventions following the chemical disaster at the Union Carbide plant in Bhopal, India, and the subsequent leak from the Union Carbide's pesticide plant in Institute, West Virginia, in mid 1980s. Participation in Responsible Care was made a condition for membership in the ACC.

Throughout the 1980s and 1990s, the program was structured around a set of codes of EHS&S management practices. In 1996 a voluntary peer-review process called Management System Verification was added to the program. The process served to verify that appropriate systems were implemented to assure ongoing compliance with company's EHS&S performance goals and external regulations. The system was not an audit of a company and did not identify non-compliance with regulations or the level of emissions at a facility.

In 2002 the ACC announced substantial changes to the Responsible Care program recognizing that US regulation of the chemical industry had caught up with RC requirements. In that year 75 percent of the original RC activities were covered by government laws and regulations compared to only 13 percent in 1988 (Phillips 2006). Stakeholders lost support for the program and the companies begun to differentiate themselves from RC because once the program practices were achieved, there was no room to advance performance. As part of its change, the program implemented the Responsible Care Management System (RCMS), a management system approach built on the basic "Plan-Do-Check-Act" philosophy to improve company performance in the key areas: community awareness and emergency response; security; distribution; employee health and safety; pollution prevention; and process and product safety

(ACC 2013). To enhance transparency, it adopted a mandatory independent third-party certification of those management systems. Under independent oversight, every Responsible Care company must certify that it has a management system in place and demonstrate progress toward improved performance. To obtain certification, companies must undergo headquarter and facility audits conducted by independent, accredited auditing firms (ACC 2013). The third party certification system was officially launched in 2005 and all members were required to complete third party audits by the end of 2007.

The ACC requires that certification is renewed every three years, and companies can choose to demonstrate conformance either to the RCMS or the RC14001 technical specification which combines Responsible Care and ISO 14001 certification. Recognition and popularity of ISO 14001with stakeholders worldwide prompted companies to seek an approach that would avoid duplicating the RC and ISO 14001 audit processes. The RC14001 technical specification integrates elements of both the RC requirement for third party certification and ISO 14001 allowing a single certification process to fulfill both program requirements (Phillips 2006). In order to obtain the RC14001, organization must conform to the ISO 14001 with respect to environment as well as to health, safety and security requirements within the scope of Responsible Care.

Unlike performance standards which set the level of environmental protection and state requirements for improved environmental performance, certified management standards such as the RC14001 only require firms to establish processes and management systems to ensure that environmental goals are developed, assessed and met. However, certification may still provide information on performance improvement to stakeholders by conveying that an environmental management system exists and whether it leads to improvement. Voluntary programs without third party oversight usually suffer from potential shirking on the part of some participants. Some firms join the program in order to reap the benefits of membership but fail to adhere to the program commitments. If certification is costly and stakeholders are willing to pay more for superior performance, certification may act as a credible signal of superior performance. According to the ACC, the third-party auditing system is part of the association's drive to increase credibility and public confidence in the RC program, since, in the past, RC signatories conducted self-assessment tests to judge their progress to full compliance. Although the ACC always mandated that all firms must adopt RC or they will lose their membership, critics questioned the credibility of the expulsion threat because ACC membership is voluntary and ACC has never expelled a member for non-compliance (Prakash 2000). The certification system is likely to formalize managerial commitment to achieving environmental performance goals (Rondinelli and Vastag 2000), provide accountability and reduce opportunities for participants to behave opportunistically (King and Lenox 2000). In addition, ACC requires public disclosure of environmental information by all ACC members on the ACC website and with governmental agencies. Therefore, we anticipate that following the implementation of third party certification of Responsible Care activities, RC participants improved their environmental performance compared to non-participants in the US chemical industry.

4. Methodology and hypotheses tested

To evaluate whether the adoption of third party certification in 2005 lead to improved environmental performance, we employ a difference-in-differences approach comparing RC plants before and after third party certification was introduced to other plants in the US chemical industry between 1995 and 2010 that were not members of RC and were therefore not subject to the requirement of third party certification. The difference-in-differences approach allows us to study the effect of treatment, in this case third party certification, by comparing the performance of the treatment group pre- and post-treatment relative to performance of the control group pre- and post-treatment. Our main hypothesis is that following the introduction of the third party certification in 2005, RC member facilities lowered their emissions of the TRI air releases by more than the control group of facilities.

To the extent that facilities may wish to mitigate the cost and stringency of current and or future mandatory regulation, we anticipate that facilities with greater HAP to TRI release ratio, which captures the exposure of facilities to regulation of HAPs, facilities located in counties classified as being out of attainment with the National Ambient Air Quality Standards (NAAQS), and facilities with a larger number of government inspections under the Clean Air Act will face an additional incentive to reduce their TRI emissions by participating in RC and have their management system certified by a third party.

To estimate the effect of RC certification on emissions, we estimate the following equation

$$(1)\ Y_{it} = \alpha + \delta T_{it} + X_{it}\beta + c_i + \lambda_t + u_{it}, \qquad t = 1, \ldots T,$$

where Y_{it} is the level of total TRI emissions to the air for facility *i* at time *t*, T_{it} is the post certification dummy equal to 1 for all RC members in years 2005-2010, λ_t represents year fixed effects, c_i captures the facility fixed effects, and u_{it} is the idiosyncratic error term. Year fixed effects control for changes in regulations and available technologies over time, while facility fixed effects control for differences among facilities that are constant over time. X_{it} is a vector of other covariates hypothesized to affect a facility's emissions: HAP-TRI release ratio, number of inspections and the number of gases for which the county where a facility is located has been out of attainment with the NAAQS. Controlling for observable differences between facilities in the treatment and the control groups improves the efficiency of the treatment effect estimator (Meyer 1995). δ is the true causal effect of the treatment on the outcome for the group receiving the treatment under the key identifying assumption that $E[u_{it}|T_{it}, X_{it}] = 0$ implying that if we are comparing facilities with the same characteristics X and in the absence of the treatment there would be no difference in the mean of those in the treatment and control groups and $\delta = 0$.

5. Data description and sources

Our data consist of chemical manufacturing facilities located in the United States that have reported emissions of toxic chemicals to the EPA's Toxic Releases Inventory (TRI). We restrict our sample to facilities that report SIC 28 and/or NAICS 325 as their primary industry, representing the largest single share of the facility's economic activity[2]. Andrew King provided us with a list of Responsible Care participants from 1988 to 2001: this is the same information utilized in King and Lennox (2000). We obtained the list of current American Chemistry Council participants and the information on their certification status between 2005 and 2010 from the American Chemistry Council website (http://reporting.responsiblecare-us.com/Reports/Members/RCMSC_Cmpny_Rpt.aspx, accessed May 14, 2012).

The commitment to RC is reported at the firm level and we assume that all facilities belonging to a participating parent firm participated in the program. We have information on the RC status for each firm in each year between 1988 and 2001. We also have information on whether firms undertook third party certification during the period 2005-2010, and we only count firms and their plants as participants in RC if they have obtained third party certification at

[2] NAICS were adopted starting with the 2006 reporting year for use within TRI instead of SIC; submissions from previous years of TRI reporting were also assigned NAICS codes based on their 2006 reporting, if any, and on their SIC codes.

the headquarters and at a sample of facilities during the periods 2005-2007 and 2008-2010. However, we do not have data on RC participation for the intervening years, i.e. 2002, 2003, 2004, and we assume that firms that were members in both 2001 and in 2005 remained members through the three years for which we have missing membership information.[3]

Since RC and non-RC facilities could be systematically different, for identification purposes we classify facilities strictly either as RC-members or as non RC-members during the period of analysis, 1995-2010. This means that we do not allow facilities to switch status. For example, if a facility was a member between 1995 and 1999 and then it ceased membership in 2000, this facility is included in the dataset as an RC-member from 1995 to 1999 and excluded from the analysis from 2000 onwards. The same is true for a facility that was traded by two parent firms that do not have the same status. However, if a facility was traded to another parent firm in year 2000 that was also a member of RC, we continue to count this facility as a member of RC. We also require that each facility has at least three years of membership status information during the period of analysis.

We obtain data on emissions of the total TRI air releases, HAP air releases, names of parent firms, and facility names and locations from the TRI (www.rtknet.org/new/tri). Information on the number of inspections under the CAA is from the Integrated Data for Enforcement Analysis database (www.epa-echo.gov/echo/index.html); county nonattainment status with the CAA is from the EPA's Green Book (www.epa.gov/oar/oaqps/greenbk).

We define facility emissions of the HAP and TRI chemicals as annual releases to air. We use air emissions of the 1995 core chemicals which have been reported to the TRI throughout our period of analysis. Firm emissions are the sum of emissions for all facilities reporting to each

[3] Based on the historical data from 1988-2001 we find that firms tend to maintain continuous membership till they choose to opt-out of the program.

parent company in each year.

County non-attainment status is the count of pollutants for which a whole or a part of the county has been designated by the EPA to be out of attainment with the NAAQS. The EPA will designate a county to be in nonattainment whenever air pollution levels persistently exceed the NAAQS for six pollutants: ozone, lead, carbon monoxide, sulfur dioxide, nitrogen dioxide and particulate matter. Non-attainment counties are under pressure to reduce emissions and this may provide an additional incentive for facilities located in these counties to lower their air emissions reported to the TRI (see also Vidovic and Khanna 2012, Bi and Khanna 2012, Gamper-Rabindran and Finger 2013).

To construct our sample we first searched the TRI to identify facilities that operate primarily in the chemical manufacturing sector. This resulted in 6,563 facilities in the continental United States. We successfully matched 4,245 facilities to 1,929 parent companies by parent firm name. Allowing for a one lagged year of data, our analysis uses an unbalanced panel of 4,169 facilities that belong to 1,866 parent firms between 1996 and 2010. Out of the 4,169 facilities, 1,478 facilities belonging to 242 parent firms were members of RC and 2,691 facilities belonging to 1,624 parent firms were not member of RC. Most facilities in our sample report to the TRI for at least three years between 1995 and 2010.

Table 1 summarizes our data. Comparing facilities in the chemical industry that adopted RC to facilities that did not adopt RC, we find that on average the adopters have higher total TRI air releases and number of inspections. On the other hand, the adopters have lower HAPs to TRI emissions ratio and were on average located in counties that are less out of attainment with the NAAQS.

Figure 1 illustrates the preliminary comparison of mean TRI emissions between the treatment and the control groups using a basic linear regression difference-in-difference estimator with no covariates and ignoring the panel nature of our data. The results indicate that although facilities in the treatment group had higher emissions before and after the treatment than the facilities in the control group, the difference between the treatment and control group facilities' emissions decreases by $-3.1*10^4$ pounds (average treatment effect) due to third party certification and it is statistically significant at the 1 percent level. This is shown in Panel A in Figure 1. Panel B shows that the decline rate of emissions from facilities that participated in Responsible Care before and after third party certification is no different than the decline rate of emissions from the facilities that did not participate in Responsible Care. The average treatment effect is 0.033 but it is not statistically significant at conventional levels of significance.

6. Results and discussion

In Table 2 we further examine the effect of third party certification on TRI emissions using a more robust parametric difference-in-difference model. In Models 1 and 2, the dependent variable is TRI air emissions measured in pounds. In Models 3 and 4, the dependent variable is the log of TRI air emissions. In all models we use the log of HAP-TRI emissions. In both cases we add one to the annual sums of emissions before taking the log to accommodate zero values. To minimize the possibility of endogeneity, we lag all time varying variables by one year relative to the year in which a facility's TRI emissions are measured. We estimate all models using robust standard errors clustered by facility and the standard errors were bootstrapped. In Models 2 and 4 we interact time dummies with the treatment indicator in order to allow the effect of the policy to change over time.

The coefficient on the treatment dummy (δ) is negative and statistically significant at the one percent level in the first two models where the dependent variable is TRI emissions in pounds indicating that on average facilities that were third party certified under RC reduced their emissions of the TRI chemicals compared to facilities that did not participate in RC and were not independently certified. The coefficient on the treatment dummy is negative albeit not statistically significant in the last two models where the dependent variable is the log of TRI emissions. This suggests that subsequent to certification the average decline rate of RC facility emissions was no different than the decline rate of emissions from non-RC facilities. However, it is worth noting that the coefficient on the treatment variable is significant at the 12 percent level in Model 4.

In Models 2 and 4 where we interact the treatment dummy with the year dummies, thus allowing the average treatment effect to vary over time, the coefficients on the interaction terms are often negative and statistically significant. Comparing Models 1 and 2 we conclude that while the introduction of third party has a negative average treatment effect between 2005 and 2010, the treatment effect seems to gather momentum in the later years (2008-2010) compared to 2005 which is the missing year category for the interaction terms. Looking at Models 3 and 4, it appears that the introduction of third party certification does not have a statistically significant average treatment effect on the decline rate of emissions in any year between 2005 and 2010, though there is weak evidence of a slightly larger decline rate for RC certified facilities in 2010. The coefficients on the control variables were generally statistically insignificant except in Models 3 and 4 where we find that facilities with higher ratio of HAP to TRI emissions also had higher TRI air releases.

Both Toffel (2006) and Russo (2009) found that early adopters of ISO 14001 experienced better environmental performance than later adopters. They argued that environmental leaders tend to move quickly when a new opportunity arises that can differentiate them from competitors in terms of environmental performance. Based on their findings we anticipated that RC certification would lead to greater reductions in emissions in the early years of the program. On the contrary, the coefficients on the interaction terms between treatment and year dummies indicate that the benefit of the change in the program structure strengthened in later years. Nonetheless, we reaffirm Toffel's overall finding that that after being certified to a voluntary program by an independent third party (ISO 14001 in his case, RC in our case), adopters reduce TRI emissions more than non-adopters.

Table 1: Descriptive Statistics

Treatment Group		Control Group		Difference Between Groups	
Variable		**Variable**		**Variable**	
TRI releases		**TRI releases**		**TRI releases**	
Mean	137986.9	Mean	57951.98	Mean	80034.92
Standard deviation	433321.6	Standard deviation	455000.9		
Median	9836	Median	755	Median	9081
HAP-TRI ratio		**HAP-TRI ratio**		**HAP-TRI ratio**	
Mean	0.67146	Mean	1.41107	Mean	-0.73961
Standard deviation	2.5540	Standard deviation	68.2899		
Median	0.7456	Median	0.61322	Median	0.13238
Inspections		**Inspections**		**Inspections**	
Mean	0.6285	Mean	0.3075	Mean	0.321
Standard deviation	2.7294	Standard deviation	1.5301		
Median	0	Median	0	Median	0
County non-attainment		**County non-attainment**		**County non-attainment**	
Mean	0.8802	Mean	0.8986	Mean	-0.0184
Standard deviation	0.9847	Standard deviation	1.0383		
Median	1	Median	1	Median	0
Facility-year observations	**13347**	**Facility-year observations**	**25121**		

Figure 1: Simple Comparison of Mean TRI Emissions Before and After Third Party Certification between Treatment and Control Groups

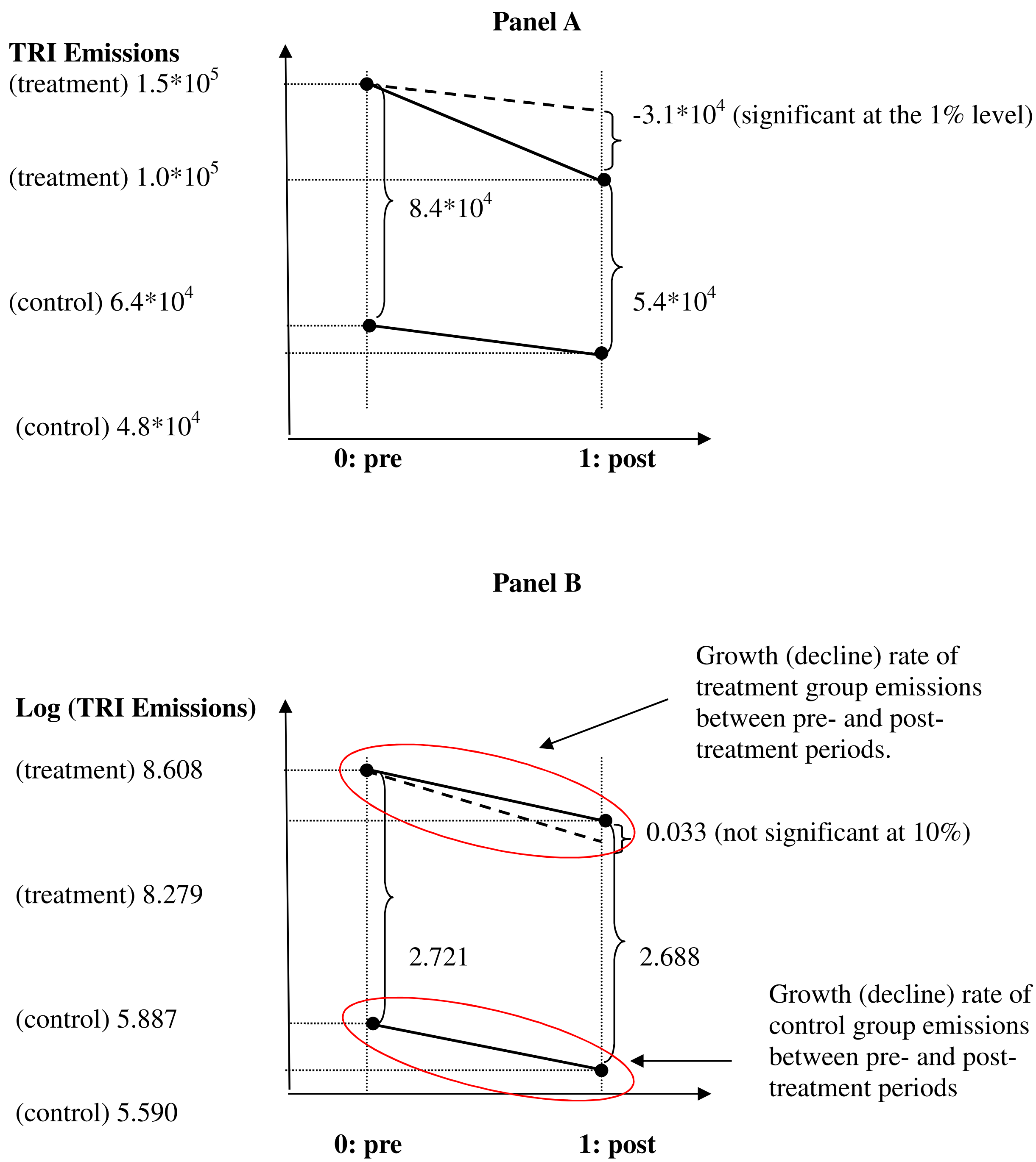

Table 2: Difference-in-Differences Estimate of the Impact of RC Third Party Certification on Facility's TRI Air Releases

Variable	Model 1	Model 2	Model 3	Model 4
Year 1997	-15578.13***	-15587.3***	-0.179***	-0.179***
	(5369.155)	(5369.754)	(0.032)	(0.032)
Year 1998	-25803.09***	-25817***	-0.276***	-0.276***
	(7441.83)	(7442.336)	(0.040)	(0.040)
Year 1999	-37389.31***	-37404.5***	-0.335***	-0.335***
	(8646.021)	(8646.685)	(0.044)	(0.044)
Year 2000	-43504.04***	-43525.1***	-0.394***	-0.394***
	(8186.651)	(8187.072)	(0.046)	(0.046)
Year 2001	-56536.95***	-56558.8***	-0.524***	-0.524***
	(10810.85)	(10811.86)	(0.051)	(0.051)
Year 2002	-50787.280***	-50805.5***	-0.585***	-0.585***
	(8160.786)	(8161.872)	(0.055)	(0.055)
Year 2003	-51548.94***	-51579.4***	-0.596***	-0.596***
	(9165.257)	(9167.487)	(0.058)	(0.058)
Year 2004	-50391.89***	-50429.8***	-0.640***	-0.640***
	(9950.959)	(9954.007)	(0.060)	(0.060)
Year 2005	-47345.260***	-50144.2***	-0.653***	-0.654***
	(9507.291)	(9367.702)	(0.066)	(0.067)
Year 2006	-50797.67***	-53131.8***	-0.828***	-0.849***
	(10216.00)	(10291.73)	(0.069)	(0.073)
Year 2007	-54140.45***	-55591.8***	-0.881***	-0.910***
	(10332.98)	(10381)	(0.072)	(0.074
Year 2008	-60091.46***	-59014.3***	-0.839***	-0.840***
	(10485.49)	(10497.15)	(0.073)	(0.076
Year 2009	-57676.35***	-54490.7***	-0.977***	-0.960***
	(11217.19)	(11486.51)	(0.074)	(0.077)
Year 2010	-56023.63***	-51851***	-0.900***	-0.851***
	(11033.24)	(11255.35)	(0.076)	(0.081)
Treatment	-48738.52***	-39271.2***	-0.011	-0.006
	(11456.66)	(9410.055)	(0.074)	(0.073)
Treatment*Year 2006	-	-1592.68	-	0.066
	-	(4142.89)	-	(0.059)
Treatment*Year 2007	-	-4391.41	-	0.096
	-	(8129.775)	-	(0.069)
Treatment*Year 2008	-	-12854.5*	-	0.003
	-	(6889.971)	-	(0.077)
Treatment*Year 2009	-	-20074**	-	-0.061

	-	(9580.6)	-	0.090)
Treatment* Year 2010	-	-23445.2***	-	-0.171*
	-	(8840.454)	-	(0.102)
Log(HAP-TRI)$_{(-1)}$	-3563.127	-3763.91	1.191***	1.189***
	(3511.109)	(3507.555)	(0.263)	(0.263)
Inspections$_{(-1)}$	244.431	255.8239	-0.002	-0.002
	(2047.395)	(2045.067)	(0.005)	(0.005)
County non-attainment$_{(-1)}$	1026.219	960.9278	-0.034	-0.034
	(3494.426)	(3495.697)	(0.041)	(0.041)
Constant	130880.10***	130993.4***	6.812***	6.812***
	(13536.65)	(13542.73)	(0.141)	(0.141)
Number of observations	33,703	33,703	33,703	33,703
Number of groups	4,169	4,169	4,169	4,169

Note: *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level. Bootstrapped robust standard errors clustered on facilities are in parentheses. In Models 1 and 2 the dependent variable is the pounds of TRI air releases while in Models 3 and 4 the dependent variable is the natural log of TRI air releases. Treatment dummy equals to 1 for all RC participants starting in year 2005. In all models the number of inspections, HAP-TRI and the number of gases for which a facility's county is out of attainment with NAAQS are lagged by one year relative to the year in which the dependent variable is measured. The number of observations reflects that our dataset starts in 1995 to allow for lags. HAP-TRI emissions ratio is measured in natural logs. All other variables are in levels.

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