Internet Appendix for
"Sustainability or Greenwashing: Evidence from the Asset Market for Industrial Pollution"

RAN DUCHIN, JANET GAO, and QIPING XU*

This document provides additional data descriptions and robustness tests. Section I provides detailed descriptions of pollution abatement activities, the procedures used to detect changes in the ownership of pollutive plants, and the industry composition of divested plants. Section II provides estimates from several robustness tests and extensions. We start by providing robustness analyses regarding the changes in pollution following divestitures, including minimum detectable effect size (MDES) estimates, OLS regression estimates, aggregate plant-level regression estimates, toxicity-weighted regression estimates, and estimates from regressions that include financial buyers. Next, we look at the changes in firms' conference call disclosures around pollutive asset divestitures conditional on the environmental pressures they face. In addition, we examine the changes in alternative ESG ratings (in addition to KLD scores) following divestitures. Finally, we analyze changes in sales prior to divestitures and the acquisition of new plants by sellers.

*Citation format: Ran Duchin, Janet Gao, and Qiping Xu, Internet Appendix for "Sustainability or Greenwashing: Evidence from the Asset Market for Industrial Pollution," *Journal of Finance* [DOI String]. Please note: Wiley is not responsible for the content or functionality of any additional information provided by the authors. Any queries (other than missing material) should be directed to the authors of the article.

I Data Description

A Pollution Abatement Activities

The figure below provides an overview of plants' pollution abatement activities under two major categories: *pollution prevention* (also referred to as *source reduction*) and *post-production processes*.

For pollution prevention, facilities must report their newly implemented source reduction activities annually by selecting 47 codes that fall under eight broad categories (ranked according to reported frequency): (1) Good Operating Practices; (2) Process Modifications; (3) Spill and Leak Prevention; (4) Raw Material Modifications; (5) Inventory Control; (6) Surface Preparation and Finishing; (7) Cleaning and Degreasing; (8) Product Modifications.

Post-production waste management includes the following: (1) Recycling, which involves a series of activities through which discarded materials are collected, sorted, processed, and converted into raw materials and used in the production of new products; (2) Energy recovery (Capture), which is the process of generating energy from the combustion of wastes, including at waste-to-energy combustion facilities and landfill-gas-to-energy facilities; and (3) Treatment, which involves the use of various processes, such as incineration or oxidation, to alter the properties or composition of hazardous materials.

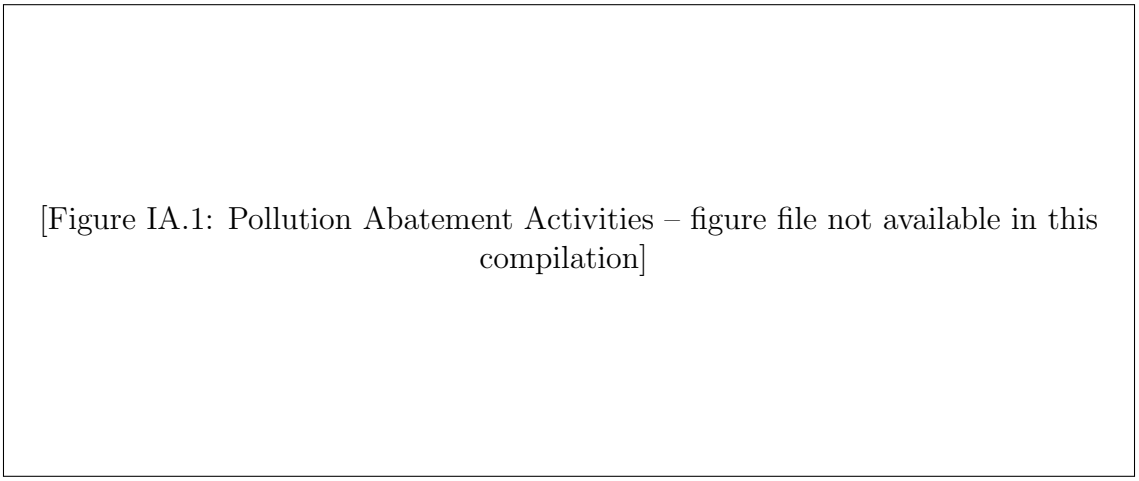


Figure IA.1. Pollution Abatement Activities

B Detecting Changes in the Ownership of TRI Plants

We track changes in the ownership of TRI plants as follows.

First, we flag all cases in which a plant's parent names change, and label the parent name before the change as the seller and the name after the change as the buyer. Parent name changes are either directly reported by the TRI, or could be detected by changes in a plant's CUSIP number.

Next, we match the buyer and seller names to those of divestiture deals from the SDC database. The matching is performed both at the subsidiary firm level and the ultimate parent level. In this process, we account for the possibility that the TRI data inaccurately captures the timing of ownership changes, and require the SDC deal year to fall within a $[-3, 3]$ year window around the year of the parent name change in the TRI database. We use SDC's deal effective date as the official date for the ownership change.

We further consider the possibility that the TRI data may not update parent information correctly in all cases. To address this concern, for each plant in TRI, we track whether it has gone through a divestiture by matching its name or its parent's name to the target name in SDC. We also require the TRI plant to fit the target's geographical location and industry classification in SDC. For example, Westmoreland Coal acquired the Roanoke Valley Energy Facility from its joint venture partner, LG&E Energy Corp in 2006. While we do not see a change of parent name for the Roanoke Valley Energy Facility in TRI, we still classify it as a divested plant.

Finally, we remove plants that have been sold multiple times during the sample period. We do so because the difference-in-difference tests struggle with the classification of repeat divestiture targets as treatment vs. control plants. Our final sample contains 888 deals.

Table IA.I
Industry Composition

This table reports the distribution of the divestitures of pollutive plants in our sample across industries. Industry classifications are based on three-digit NAICS codes.

NAICS3	Industry	Observations
325	Chemical Manufacturing	258
332	Fabricated Metal Product Manufacturing	117
311	Food Manufacturing	89
336	Transportation Equipment Manufacturing	73
424	Merchant Wholesalers, Nondurable Goods	72
331	Primary Metal Manufacturing	66
334	Computer and Electronic Product Manufacturing	63
326	Plastics and Rubber Products Manufacturing	53
333	Machinery Manufacturing	47
322	Paper Manufacturing	45
321	Wood Product Manufacturing	39
324	Petroleum and Coal Products Manufacturing	31
335	Electrical Equipment, Appliance, and Component Manufacturing	30
221	Utilities	25
327	Nonmetallic Mineral Product Manufacturing	21
562	Waste Management and Remediation Services	12
339	Miscellaneous Manufacturing	12
312	Beverage and Tobacco Product Manufacturing	10
112	Animal Production and Aquaculture	9
323	Printing and Related Support Activities	7
212	Mining (except Oil and Gas)	7
316	Leather and Allied Product Manufacturing	5
337	Furniture and Related Product Manufacturing	4
313	Textile Mills	3
493	Warehousing and Storage	3
811	Repair and Maintenance	1
314	Textile Product Mills	1
315	Apparel Manufacturing	1
517	Telecommunications	1

II Robustness Tests and Extensions

Table IA.II
MDES for Pollution Estimates

This table presents minimum detectable effect size (MDES) estimates for the results in Table IV of the main paper. The unit of observation is a plant-chemical-year. *Total Pollution* is the total amount of annual toxic release for a plant-chemical pair. *Pollution Intensity* is the total amount of annual toxic release scaled by the cumulative production ratio for a plant-chemical pair. The sample includes all plants in the Toxic Release Inventory Program of the United States Environmental Protection Agency. MDES for 80% detect probability is computed as the standard error of the coefficient estimates times 2.49, and MDES for 90% detect probability is computed as the standard error of the coefficient estimates times 2.93. Each MDES is scaled by the standard deviation of the log of the dependent variable. Standard errors are presented in parentheses and clustered by plant. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Dep. Var.:	*Total Pollution*				*Pollution Intensity*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divested × *Post* Coefficient	0.030	0.022	0.024	0.041	0.046	0.027	0.044	0.065
Std. Err.	(0.035)	(0.037)	(0.035)	(0.040)	(0.046)	(0.046)	(0.048)	(0.049)
MDES (80%)	0.087	0.092	0.087	0.100	0.115	0.115	0.120	0.122
Rel. to Std of Log(Dep. Var.):	2.45%	2.59%	2.45%	2.80%	3.16%	3.16%	3.29%	3.36%
MDES (90%)	0.103	0.108	0.103	0.117	0.135	0.135	0.141	0.144
Rel. to Std of Log(Dep. Var.):	2.89%	3.05%	2.89%	3.30%	3.71%	3.71%	3.88%	3.96%
Plant-Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chemical-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-Year FE		Yes	Yes	Yes		Yes	Yes	Yes
Industry-Year FE			Yes	Yes			Yes	Yes
Method	GDID	GDID	GDID	Stacked	GDID	GDID	GDID	Stacked
Observations	992,424	992,418	992,313	3,994,695	992,424	992,418	992,313	3,994,695

Table IA.III
Changes in Pollution Following Divestitures: Robustness Tests

Panel A provides OLS regression estimates from plant-by-chemical specifications. Panel B provides Poisson regression estimates that aggregate annual pollution across all the chemicals in each plant. Panel C provides Poisson regression estimates from toxicity-weighted measures of chemical emissions in each plant-year. *Total Pollution* is the total toxic release for a plant-chemical-year (or a plant-year in Panel A). *Pollution Intensity* is the ratio of total pollution to a chemical's production ratio (or the number of plant employees in Panel A). *RSEI Hazard* is the toxicity-weighted pollution amount, while *RSEI Score* incorporates both toxicity weights and modeled population exposure to gauge the impact on public health. *Divested* is an indicator that equals one if a plant has been divested by its parent during the sample period. *Post* is an indicator that equals one in the years following the divestiture. In each panel, we present estimates from generalized difference-in-difference (GDID) regressions (columns (1) through (3) and (5) through (7)) and estimates from stacked regressions (columns (4) and (8)). The stacked samples consist of divested plants and matched never-divested plants within the same NAICS3 industry and state. In stacked regressions, all fixed effects are interacted with cohort indicators, where a cohort includes all divested plants sharing the same event year and their matched never-divested control plants. Standard errors are presented in parentheses and clustered by plant. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A. Pollution at Divested Plants, OLS

Dep. Var.:	*Total Pollution*				*Pollution Intensity*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divested × *Post*	1337.700*	951.780	867.399	1227.699	1984.599	1767.528	1657.015	1575.420
	(705.732)	(714.626)	(692.427)	(813.793)	(1401.805)	(1398.385)	(1429.632)	(1401.613)
Plant-Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chemical-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-Year FE		Yes	Yes	Yes		Yes	Yes	Yes
Industry-Year FE			Yes	Yes			Yes	Yes
Method	GDID	GDID	GDID	Stacked	GDID	GDID	GDID	Stacked
Observations	1,035,411	1,035,405	1,035,311	3,427,189	1,035,411	1,035,405	1,035,311	3,427,189
R^2	0.804	0.805	0.810	0.811	0.793	0.793	0.796	0.785

Panel B. Plant-level Pollution at Divested Plants

Dep. Var.:	*Total Pollution*				*Pollution Intensity*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divested × *Post*	0.064	0.046	0.008	0.062	0.107	0.131	0.124	0.181
	(0.044)	(0.045)	(0.042)	(0.043)	(0.110)	(0.098)	(0.101)	(0.115)
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-Year FE		Yes	Yes	Yes		Yes	Yes	Yes
Industry-Year FE			Yes	Yes			Yes	Yes
Method	GDID	GDID	GDID	Stacked	GDID	GDID	GDID	Stacked
Observations	334,852	334,838	334,683	752,404	269,656	269,635	269,474	619,862
R^2	0.909	0.912	0.917	0.925	0.857	0.863	0.867	0.886

Panel C. Plant RSEI at Divested Plants

Dep. Var.:	*Total Pollution*				*Pollution Intensity*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divested × *Post*	0.065	0.038	0.028	−0.072	0.029	0.042	0.017	0.025
	(0.103)	(0.111)	(0.102)	(0.191)	(0.110)	(0.107)	(0.101)	(0.172)
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-Year FE		Yes	Yes	Yes		Yes	Yes	Yes
Industry-Year FE			Yes	Yes			Yes	Yes
Method	GDID	GDID	GDID	Stacked	GDID	GDID	GDID	Stacked
Observations	316,806	316,790	316,626	723,559	312,530	312,514	312,341	716,206
R^2	0.877	0.883	0.887	0.925	0.864	0.869	0.873	0.919

Table IA.IV
Changes in Pollution Following Divestitures: Including Financial Buyers

This table presents estimates from difference-in-difference Poisson regressions explaining the pollution levels of divested plants around their divestitures. The unit of observation is a plant-chemical-year. The sample includes deals with financial buyers. *Divested* is an indicator that equals one if a plant has been divested by its parent during the sample period. *Post* is an indicator that equals one in the years following the divestiture. We present estimates from generalized difference-in-difference (GDID) regressions (columns (1) through (3) and (5) through (7)) as well as estimates from stacked regressions (columns (4) and (8)). The stacked samples consist of divested plants and matched never-divested plants within the same NAICS3 industry and state. In stacked regressions, all fixed effects are interacted with cohort indicators, where a cohort includes all divested plants sharing the same event year and their matched never-divested control plants. Standard errors are presented in parentheses and clustered by plant. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Dep. Var.:	*Total Pollution*				*Pollution Intensity*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divested × *Post*	−0.000	−0.013	−0.009	0.006	0.030	0.013	0.030	0.072
	(0.035)	(0.037)	(0.035)	(0.042)	(0.044)	(0.044)	(0.045)	(0.053)
Plant-Chemical FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chemical-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State-Year FE		Yes	Yes	Yes		Yes	Yes	Yes
Industry-Year FE			Yes	Yes			Yes	Yes
Method	GDID	GDID	GDID	Stacked	GDID	GDID	GDID	Stacked
Observations	992,424	992,418	992,313	3,900,853	992,424	992,418	992,313	3,900,853

Table IA.V
Conference Call Disclosures and Environmental Pressures

This table provides estimates from regressions that examine the relation between divestitures, conference call disclosures, and environmental pressures. The unit of analysis is a firm-year. The dependent variable is *Positive Env. Disclosure*, defined as an indicator that equals one if the firm reports positive environmental progress during its earnings conference call. *Seller (Pollutive)* is an indicator that equals one if the firm divests a pollutive plant during the sample period. *Post* is an indicator that equals one in the years following the divestiture. *High Env Pressure* is an indicator that equals one if the firm faces above-median environmental pressures (*Pressure Index*) in a given year. *Low Env Pressure* is an indicator that equals one if the firm faces below-median environmental pressures (*Pressure Index*) in a given year. Standard errors are reported in parentheses and clustered by firm. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Dep. Var.: *Positive Env Disclosure*	(1)	(2)	(3)	(4)
Seller (Pollutive)×Post×High Env Pressure	0.066**	0.059*	0.064**	0.070**
	(0.029)	(0.030)	(0.030)	(0.030)
Seller (Pollutive)×Post×Low Env Pressure	0.021	0.008	0.011	0.018
	(0.056)	(0.057)	(0.057)	(0.057)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes			
Industry-Year FE		Yes	Yes	Yes
Firm Char			Yes	Yes
Method	GDID	GDID	GDID	Stacked
Observations	37,923	37,796	33,873	237,867
R^2	0.468	0.499	0.520	0.496

Table IA.VI
Alternative ESG Ratings

This table presents estimates from difference-in-difference OLS regressions explaining sellers' ESG ratings around divestitures of pollutive plants. We use rating data from Refinitiv and MSCI to augment the ESG ratings from the KLD database. We standardize all rating observations across the three datasets, and fill observations with missing KLD ratings using the standardized ratings from Refinitiv and MSCI if available. The dependent variable in columns (1) to (4) is *Overall CSR Score*, and the dependent variable in columns (5) to (8) is *Environmental Scores*. *Seller (Pollutive)* is an indicator that equals one if a firm divests a pollutive plant during the sample period. *Post* is an indicator that equals one in the years following the divestiture. *Firm Char* includes *Q*, *Leverage*, *Cash Holdings*, and *Tangibility*. Columns (1) through (3) and (5) through (7) report estimates from generalized difference-in-difference (GDID) regressions. Columns (4) and (8) report results from stacked regressions. The stacked sample consists of sellers and matched control firms within the same NAICS3 industry that have not sold a plant during the sample period. In the stacked regressions, all fixed effects are interacted with cohort indicators, where a cohort includes all divesting firms sharing the same event year and their matched never-divesting control firms. Standard errors are reported in parentheses and clustered by firm. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Dep. Var.:	*Overall CSR Scores*				*Environment Scores*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Seller (Pollutive) × *Post*	0.232***	0.194**	0.201***	0.211***	0.516***	0.372***	0.374***	0.363***
	(0.079)	(0.077)	(0.077)	(0.081)	(0.110)	(0.108)	(0.109)	(0.113)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes				Yes			
Industry-Year FE		Yes	Yes	Yes		Yes	Yes	Yes
Firm Char			Yes	Yes			Yes	Yes
Method	GDID	GDID	GDID	Stacked	GDID	GDID	GDID	Stacked
Observations	41,314	41,144	40,066	178,824	41,308	41,138	40,060	178,798
R^2	0.580	0.616	0.611	0.607	0.496	0.544	0.543	0.532

Table IA.VII
Changes in Regulatory Costs for Remaining Plants

This table reports regression estimates explaining changes in the enforcement costs for unsold plants around the divestitures of other pollutive plants (i.e., peer plants). The sample includes all public firms owning plants in the Toxic Release Inventory Program of the United States Environmental Protection Agency (EPA). *Enforcement Action* is an indicator that equals one if a firm's unsold plants receive an EPA enforcement action in a given year. *Enforcement Costs* is the dollar amount (in millions) of regulatory costs incurred by the firm's unsold plants due to EPA enforcement actions, including fines and cleanup costs. The latter is defined only for firm-years with at least one enforcement action. *Seller (Pollutive)* is an indicator that equals one if a firm divests a pollutive plant during the sample period. *Post* is an indicator that equals one in the years following the divestiture. *Firm Char* includes *Q*, *Leverage*, *Cash Holdings*, and *Tangibility*. We report results from generalized difference-in-difference (GDID) regressions in columns (1) to (3) and (5) to (7), and from stacked regressions in columns (4) and (8). In the stacked regressions, the sample consists of sellers and matched control firms within the same NAICS3 industry that have not sold a plant during the sample period, and all fixed effects are interacted with cohort indicators where a cohort includes all divesting firms sharing the same event year and their matched never-divesting firms. Standard errors are reported in parentheses and clustered by firm. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Dep. Var.:	*Enforcement Action*				*Enforcement Costs*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Seller (Pollutive) × *Post*	−0.042***	−0.043***	−0.044***	−0.073***	−2.204***	−2.685***	−3.452***	−4.508***
	(0.012)	(0.013)	(0.013)	(0.019)	(0.706)	(0.689)	(1.067)	(1.007)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes				Yes			
Industry-Year FE		Yes	Yes	Yes		Yes	Yes	Yes
Firm Char			Yes	Yes			Yes	Yes
Method	GDID	GDID	GDID	Stacked	GDID	GDID	GDID	Stacked
Observations	18,620	18,333	17,129	126,887	6,749	5,452	5,044	49,167
R^2	0.281	0.310	0.316	0.293				

Table IA.VIII
Sales Growth before Divestitures

This table presents difference-in-difference OLS regression estimates for the sales growth rates of divested and never-divested plants over the five years leading to the divestiture. The divestiture year is the omitted benchmark year. Column (1) presents generalized difference-in-difference regression estimates and column (2) reports stacked regression estimates. All the fixed effects in column (2) are interacted with cohort fixed effects, where a cohort includes all divested plants sharing the same event year and their matched never-divested control plants. Standard errors are presented in parentheses and clustered by plant. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

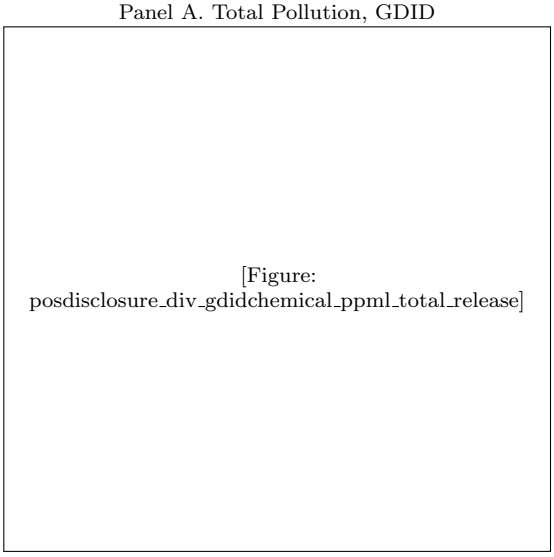
Dep. Var.: *Sales Growth*	(1)	(2)
Sell (Pollutive) × *D(year=−5)*	0.001	−0.003
	(0.033)	(0.039)
Sell (Pollutive) × *D(year=−4)*	−0.004	−0.022
	(0.030)	(0.032)
Sell (Pollutive) × *D(year=−3)*	0.031	0.032
	(0.031)	(0.036)
Sell (Pollutive) × *D(year=−2)*	0.011	0.017
	(0.030)	(0.033)
Sell (Pollutive) × *D(year=−1)*	−0.035	−0.030
	(0.025)	(0.028)
Plant FE	Yes	Yes
Year FE	Yes	Yes
State-Year FE	Yes	Yes
Industry-Year FE	Yes	Yes
Cohort-Interacted FEs		Yes
Observations	265,445	157,546
Adjusted R^2	0.021	0.112
Method	Generalized DID	Stacked Regression
Model	OLS	OLS

Table IA.IX
Acquisition of New Plants

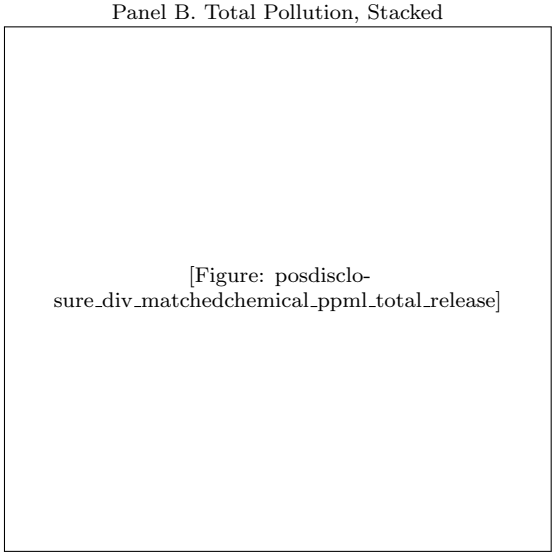
This table provides estimates from regressions that examine new plant acquisitions by sellers around divestitures of pollutive plants. The unit of observation is a firm-year. *Seller (Pollutive)* is an indicator that equals one if a firm divests a pollutive plant during the sample period. *Post* is an indicator that equals one in the years following the divestiture. *D(New Plant)* is an indicator that equals one if the firm acquires any new plants in a given year. *Num(New Plants)* is the total number of new plants acquired in a given year. *Firm Char* includes *Q*, *Leverage*, *Cash Holdings*, and *Tangibility*. Columns (1) through (3) and (5) through (7) report estimates from generalized difference-in-difference (GDID) regressions. Columns (4) and (8) report results from stacked regressions. The stacked sample consists of sellers and matched control firms within the same NAICS3 industry that have not sold a plant during the sample period. In the stacked regressions, all fixed effects are interacted with cohort indicators, where a cohort includes all divesting firms sharing the same event year and their matched never-divesting control firms. Standard errors are reported in parentheses and clustered by firm. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Dep. Var.:	*D(New Plant)*				*Num(New Plants)*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Seller (Pollutive) × *Post*	−0.065***	−0.066***	−0.062***	−0.067***	−0.106***	−0.108***	−0.106***	−0.108***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.025)	(0.026)	(0.026)	(0.026)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes			Yes	Yes		
Industry-Year FE			Yes	Yes			Yes	Yes
Firm Char		No	Yes	Yes		No	Yes	Yes
Method	GDID	GDID	GDID	Stacked	GDID	GDID	GDID	Stacked
Observations	14,130	13,803	13,110	86,080	14,130	13,803	13,110	86,080
R^2	0.223	0.269	0.273	0.227	0.262	0.305	0.312	0.260

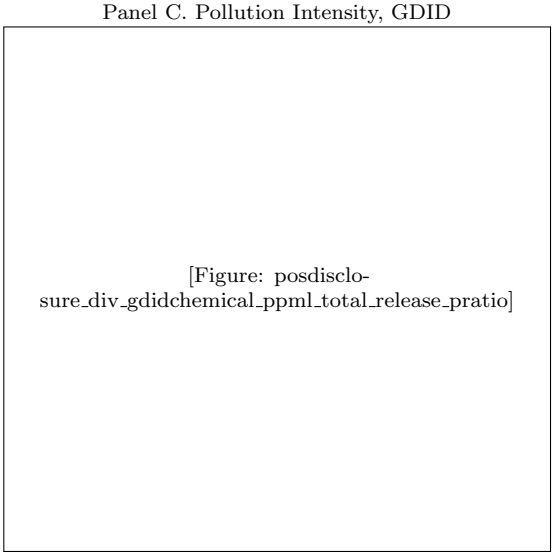
Panel A. Total Pollution, GDID



Panel B. Total Pollution, Stacked



Panel C. Pollution Intensity, GDID



Panel D. Pollution Intensity, Stacked

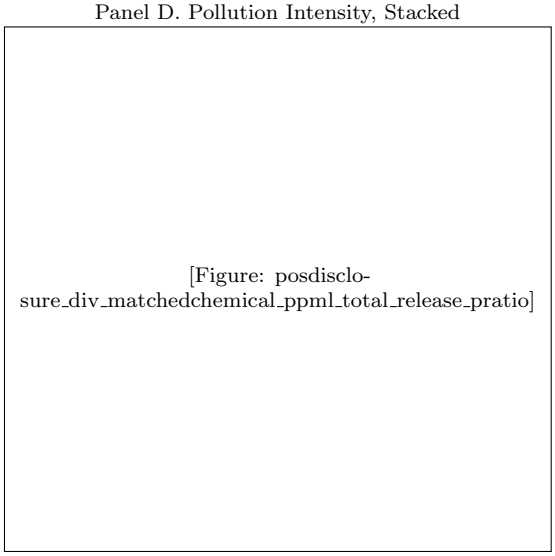


Figure IA.2. Pollution around divestitures accompanied by positive environmental disclosures. This figure reports annual pollution levels and pollution intensities at the plant-chemical level around divestitures of pollutive plants accompanied by positive environmental disclosures. *Total Pollution* is the total annual toxic release for a plant-chemical pair. *Pollution Intensity* is the total annual toxic release scaled by the cumulative production ratio for a plant-chemical pair. We present estimates from generalized difference-in-difference (GDID) regressions in Panels A and C, and estimates from stacked regressions in Panels B and D. The stacked samples consist of divested plants and matched never-divested plants within the same NAICS3 industry and state. The regressions include plant-chemical, chemical-year, industry-year, and state-year fixed effects. In the stacked regressions, all the fixed effects are interacted with cohort indicators, where a cohort includes all divested plants sharing the same event year and matched never-divested control plants. The dashed vertical lines represent 95% confidence intervals based on standard errors clustered by plant.

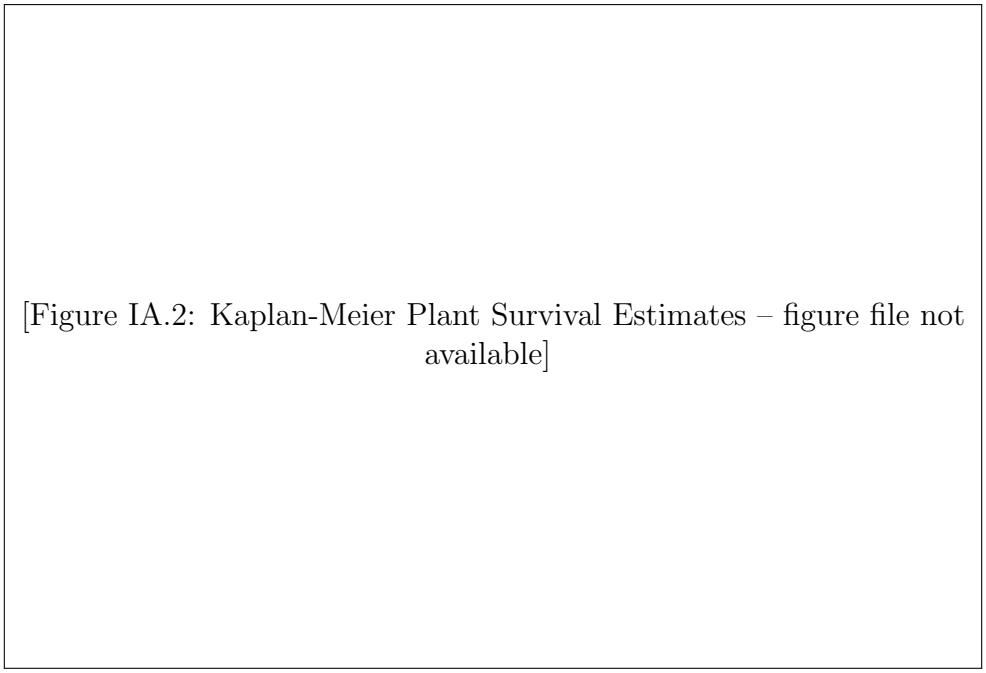


Figure IA.3. Plant survival rates. This figure presents Kaplan-Meier survival estimates of divested pollutive plants and matched never-divested pollutive plants within the same NAICS3 industry and state. The sample period is 2000 to 2020. Pollutive plants are plants in the Toxic Release Inventory Program of the United States Environmental Protection Agency.