Corporate Emissions and Profits

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Abstract

This study examines the link between corporate emissions and operating profits as well as its interaction with carbon pricing. We match facility-level emissions data verified through the EU Emissions Trading System with firm-level financial data to estimate this link, which is of fundamental interest and also central importance to carbon policies. Despite much prior evidence to the contrary, we find that increasing carbon emissions increases corporate profits of the average firm. A one-ton increase in annual carbon emissions is associated with a €3.30 rise in same-year operating profits (or €8.60 in manufacturing), controlling for firm activity. This link persists at least over a five-year horizon, implying that emission reductions in a given year are associated with lower operating profits for at least five years. The estimated profit impact is remarkably stable across a series of research design choices common in prior work. We exploit variation in emission intensities driven by carbon allowance shortfalls to address standard concerns about endogeneity and find, as expected, that the link strengthens when firms are forced to reduce their carbon emissions. The link weakens predictably with increases in the carbon price, consistent with firms trading off costs of carbon allowances against abatement costs. This finding as well as our evidence on the fundamental link between emissions and profits cast doubt on the widespread narrative that "it pays to be green" and highlight the need to address corporate externalities through carbon policies, as firms are unlikely to have sufficient incentives for voluntary abatement investments.

Acknowledgments

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1. Introduction

The link between corporate sustainability and firms' financial performance has been studied extensively and is the subject of a long-standing debate (Friede et al. 2015). The reason is that it has profound implications for the need and design of environmental policies (Porter and van der Linde 1995; Palmer et al. 1995). A common narrative in the literature is that firms can "Do Well by Doing Good" (Porter and Kramer 2011) or that it pays to be green. Indeed, most of the empirical evidence is consistent with this narrative, finding a positive, or at least non-negative, link between environmental and financial performance, mostly in the cross-section (Atz et al. 2022; Friede et al. 2015).

Conceptually, however, this link rests on weak grounds. Basic economic theory implies that sustainability policies act like a constraint on firm behavior and that avoiding or addressing externalities is costly to firms (e.g., Jensen 2010). Moreover, even if there are sustainability initiatives that allow firms to save costs or address inefficiencies, it is unclear whether they are sufficiently pervasive so that one would find that sustainability investments on average increase firm profits (Palmer et al. 1995). Given this divide between theory and prior empirical evidence, we revisit this fundamental link in the context of corporate carbon emissions, which is likely the largest externality of corporate activity (e.g., Greenstone et al. 2023) and the center of many sustainability initiatives and policies. We explore how the link between corporate emissions and profits changes with carbon pricing.

Estimating the link between corporate sustainability and firm performance is empirically challenging. First, corporate sustainability is a multi-dimensional concept and difficult to measure (Bénabou and Tirole 2010; Christensen et al. 2021). Much of the existing literature relies on ESG ratings which substantially vary across providers, mix corporate impact with ESG risk, and

produce vastly different inferences depending on the rating methodology employed (Berg et al. 2022). Second, the voluntary nature of firms' sustainability activities raises selection and reverse causality concerns, as more profitable firms are likely more inclined to engage in sustainability activities (Dechezleprêtre et al. 2019; Bénabou and Tirole 2010). Lastly, data vendors often estimate firms' environmental performance using models that are predominantly a function of firm sales and other firm fundamentals, raising the concern that environmental performance reflects the underlying firm fundamentals (Aswani et al. 2024a; Zhang 2024).

We overcome these issues by studying the link between corporate carbon emissions and profits in the context of the EU Emissions Trading System (EU ETS). The EU ETS is the first and largest cap-and-trade system of carbon emissions. In contrast to other, mostly estimated data, the EU ETS provides actual and externally verified facility-level emissions data for compliance purposes. These data can be matched to corporate financial data for private and public firms. The institutional features of the EU ETS also allow us to implement tighter empirical designs. Specifically, the total number of carbon allowances and the allocation mechanism (free vs. auctioned) vary significantly across and within the different phases of the EU ETS.[1] We exploit these regime changes to identify changes in emission intensity that are driven by a carbon allowance shortfall, that is the percentage of carbon emissions not covered by allowances (freely) granted to the firm. Furthermore, the EU ETS exhibits considerable time-series variation in carbon prices (see Figure 4 for an overview). This variation aids our analysis in several ways. The very low carbon prices in earlier phases allow us to observe verified data of facility-level emissions in an environment reasonably close to an "unpriced" setting. That is, the low carbon prices in these

[1] So far, there are four phases of the EU ETS: Phase I (2005-2007), Phase II (2008-2012), Phase III (2013-2020) and Phase IV (2021-2030).

phases are unlikely to explain any direct effect on operating profits, although expectations of higher future prices could still trigger abatement decisions, which in turn generates variation in carbon intensities. The higher carbon prices in later ETS phases in turn provide variation to explore the sensitivity of the emissions-profit link to changes in the carbon price.

For our empirical analysis, we combine emission data from compliance files of the EU Transaction Log with financial data of both public and private companies from Orbis. For each company, we aggregate emissions across all its installations covered under the EU ETS and compute an emission intensity measure scaled by the firm's total assets. To validate this measure and the tightness of match between our emission and financial data, we first check whether several stylized facts established in prior literature hold for our sample. Table 1 shows considerable variation in emission intensities across and within industries with the largest emission intensities observable in the electricity sector (Greenstone et al. 2023). In Figure 2, we plot the time-series of 90-10 productivity differentials within granular sub-industries in the manufacturing sector. Consistent with Lyubich et al. (2018), we find that carbon emissions productivity (i.e., the inverse of emission intensity) exhibits a much larger dispersion across firms than other standard input productivities, but this dispersion decreases toward later phases of the EU ETS.

Our first formal set of analyses aims to establish a baseline relation between firms' emission intensity and operating profits. We focus on intensities to control for firm scale and activity. In Table 2, we find a robust positive association between firms' emission intensity and their operating profit (scaled by assets, i.e., return on assets). Importantly, the association strengthens with the inclusion of firm fixed effects, which essentially relates changes in emissions intensities to changes in operating profits. The positive relation also holds with country-year fixed effects, accounting for (arbitrary) changes in local regulation or local carbon pricing. In terms of economic magnitude,

the coefficients we estimate translate to an increase of more than €3.00 in same-year operating profits for each additional ton of annual carbon emissions, holding total assets fixed. For manufacturing firms, we estimate significantly larger magnitudes of around €8.00 per additional ton of emissions (see Table OA1).

A key challenge when estimating the link between emissions and profits is that, for firms with positive operating margins, increases in firm activity tend to imply higher operating profits. Since emissions are highly correlated with firm activity, any positive association could simply reflect differences in firm activity (rather than in emission intensities). To gauge this concern, we add controls for (changes in) both asset productivity and sales growth. We also estimate variants of our main specification scaling emissions by operating revenues (Table 3, Panel A) and find that the coefficient on emission intensity is stable across all these specifications. Related to this concern, we note that the measurement and scaling of carbon emissions in empirical analyses have been heavily debated in the finance literature (Aswani et al. 2024a; Bolton and Kacperczyk 2024; Aswani et al. 2024b). However, we do not find much sensitivity of our results to the decision to scale emissions or to the choice of scalar (Table 3, Panel A). Instead, our results suggest that many of the concerns about emission scaling are not first order when working with actual rather than estimated emissions data.

Although the EU ETS has the advantage of reliably measured corporate emissions, it also poses challenges. For one, we need to explicitly take into account the role of carbon allowances in our estimation. A concern in earlier phases of the EU ETS are windfall profits from generously granted free allowances. Any excess free allowances may be profitably sold in secondary carbon markets while the opportunity cost of free allowances may be passed through to product prices (Sijm et al. 2006). Such windfall profits could lead to a spurious association between emissions

and corporate profits if carbon-intensive firms benefited more from the generous allocation of free allowances. Since the percentage of carbon allowances granted for free varies over our sample period, the inclusion of firm fixed effects only partially accounts for this effect. However, we can mitigate the influence of windfall profits directly using the transaction-based data in the EU ETS. In Table 3, Panel B we both separately control for different measures of carbon allowances granted (total, sold and excess) and directly adjust operating profits by the value of carbon allowances sold. The coefficient on emission intensity remains positive and comparable in magnitude across all these specifications but declines by a third when directly adjusting for carbon allowance sales. Thus, windfall profits from free allocation of carbon allowances have a non-negligible impact on operating profits, but they do not explain the positive association between emission intensities and operating profits we document.

To further rule out the confounding effect of carbon pricing and to ascertain that the estimated link between firm emissions and profits is not unique to carbon, we employ data on firms' other air and water pollutants from the European Pollutant Release and Transfer Register (E-PRTR). In Table 9, we aggregate all reported air pollutants excluding carbon emissions for each firm and find a similar positive within-firm association between (changes in) air pollutant intensity and (changes in) operating profits, irrespective of asset or revenue scaling. Hence, the positive relation between corporate emissions and profits is neither carbon-specific nor an artefact of the EU ETS, but extends more broadly to other unpriced corporate emissions.

Our analysis so far is silent on the origin of the variation in corporate emission intensities across firms and time. If emission reductions are costly, why do some firms engage in them? In addition, there is the concern that variation in emission intensities is endogenously related to firm profits. To tighten our empirical design and exploit exogenous variation, we leverage the

institutional features of the EU ETS. Specifically, the total number of carbon allowances and the allocation mechanism (free vs. auctioned) vary significantly across and within the different phases of the EU ETS. We exploit the carbon allowance shortfall produced by these regime changes to instrument for changes in emission intensity. In line with prior literature (Dechezleprêtre et al. 2023; Venmans 2016) we find a strong first-stage, that is, shortfalls predict emission reductions. Figure 1 shows the relation between the carbon allowance shortfall at the beginning of each phase and changes in emission intensity over the entire phase thereafter. Even in earlier phases when EU ETS prices were fairly low, the carbon allowance shortfall seems to be a strong predictor of future emission abatement. Next, we use the change in emission intensity induced by carbon allowance shortfalls in an instrumental variable design. We find that the positive association between emissions and operating profitability strengthens significantly with the IV specification relative to the OLS specification (see Table 4), which makes economic sense as the IV variation essentially identifies firms that are forced to reduce their emissions due to the shortfall and hence should have higher abatement costs by revealed preference.

To unpack the positive relation between corporate emissions and operating profits, we first examine the relation for other profitability measures that differ in the extent to which they deduct certain cost components. Table 5 shows a very similar economic magnitude for the EBIT margin,[2] but a much weaker relation (about a third of the magnitude for operating ROA) for the EBITDA margin.[3] This suggests that depreciation and underlying investments are key drivers of the positive relation we document. We explore this investment channel more directly using two different proxies for firms' investment into their assets base. For both depreciation and capital expenditures,

[2] Earnings before interest and taxes as % of sales
[3] Earnings before interest, taxes, depreciation and amortization as % of sales

we find a strong inverse relationship with emission intensity. These results hold both in the OLS as well as IV specifications (see Table 4) and suggest that emission reductions require significant capital investments, which raise annual depreciation and ultimately lower operating profits.

Given the previously documented investment channel, it raises the question whether the negative profit impact from emission reductions is simply a short-term effect which dissipates or even flips in the long-run (Busch et al. 2022). We test this idea using longer-horizon differences in operating ROA and emission intensity. In Table 6, Panel A we find that the positive relation between corporate emissions and profits persists at least up to a five-year horizon. For a much smaller sample of public firms, we use Tobin's q to capture (anticipated) net economic effects of corporate emissions even more long-run than the 5-year horizon. While estimates are noisy due to sample size, our results suggest that the positive relation with corporate emissions also holds for Tobin's q in earlier phases of the EU ETS but attenuates or turns negative in later phases.

Conceptually, the relation between corporate emissions and profits is also a function of firms' ability to pass through costs and the availability of cost-effective carbon abatement technologies within industries. We present evidence consistent with both moderating factors in Table 7. In Panel A, we run our baseline specification from Table 2 separately for each key industry-sector in our sample. We generally find the strongest relation between corporate emissions and profits in sectors in which carbon emissions are likely a major (quasi-)input in the production process such as manufacturing or transportation. In contrast, the electricity sector exhibits the weakest association (see Figure 3, Panel D) possibly due to stricter price controls based on cost-plus pricing. In Panel B, we estimate the cross-sectional heterogeneity of the profitability-emissions link to 90-10 carbon productivity differentials within sub-industries. The negative interaction indicates that the profit

impact from emission reductions is attenuated for firms in industries with larger carbon productivity dispersion consistent with firms facing lower abatement costs in these industries.

Finally, we explore changes in the relation between corporate emissions and profits across the different EU ETS phases and more specifically its interaction with carbon pricing. When decomposing our sample period into ETS phases I & II (2005-2012), III (2013-2020) and IV (2021-), we find a positive impact of corporate emissions in the first three phases which flips negative (albeit statistically insignificant) in the fourth phase (see Table 8, Panel A). A similar time-series pattern emerges when focusing on changes in operating ROA over each entire phase and instrumenting emission intensity changes with the carbon allowance shortfall at the beginning of each phase (see Table 8, Panel B). This time-series heterogeneity appears to be driven by changes in the underlying EU ETS carbon price as we document a significant negative interaction between emission intensity and carbon price that is robust to other ETS phase-specific effects, country-year fixed effects and linear time trends.

Our study makes several contributions to the literature. First, we revisit the frequently-studied and much-debated relation between corporate emissions and profits (Friede et al. 2015; Atz et al. 2022). We show, in contrast to many studies, that this relation is robustly positive as predicted by economic theory and the notion that the costs of carbon emissions are not internalized by firms. Our setting offers several advantages to uncover and re-estimate this fundamental link, including reliable measurement of emissions and matching with firm activity and financial performance for a broad and large sample of private and public firms. We also exploit exogenous variation to corroborate our within-firm analysis showing a positive link between emissions and profits, which addresses many of the identification concerns that have plagued prior studies.

Second, our study contributes to a growing literature on the firm-level economic effects of carbon pricing schemes such as the EU ETS (see Martin et al. 2016 for a detailed review). Most of this literature focuses on the effects of carbon pricing on firm behavior and the costs of the induced real effects, finding significant emission reductions and largely negligible effects on firm profits (e.g., Colmer et al. 2025; Dechezleprêtre et al. 2023). In contrast to these studies, we do not study the impact of the ETS upon introduction, but focus on variation in emission intensities within the EU ETS, how firms respond to changes in carbon pricing as well as how carbon pricing changes the fundamental link between emissions and operating profits. We also extend this literature by tracking the relation across all four phases of the EU ETS in a large sample. Prior evidence was restricted to earlier phases where carbon prices were low.

2. Data and Sample

We obtain verified emissions for installations covered under the EU ETS from EUETS.INFO which pre-processes data from the EU Transaction Log (EUTL).[4] EUETS.INFO is a common source of EU ETS data in the literature and provides us with relational tables between installations, accounts and accountholders scraped from installation operator details in the EUTL (Abrell 2024). For financial data, we rely on Orbis Bureau van Dijk which provides financial statement information for a broad sample of public and private companies in Europe. To merge with firm-level financials we aggregate installation-level emissions for each accountholder, which is the level at which the legal entity owning one or more installations is defined.

A key step in compiling our sample is matching accountholders to firms in Orbis. Since we identified major inconsistencies in the matches provided by the European Commission's Joint Research Centre (JRC), we implement a careful matching procedure: First, we use GPT to validate and choose among competing existing matches from the EC JRC and European Commission's Directorate General GROW (DG GROW) based on name and location information. Second, for the remaining accountholders, we use the Orbis batch search function to identify additional potential matches in three different rounds with varying matching information (from most to least restrictive):

a. National Registration Number, Name, City, Country (*most restrictive*)

b. Name, City, Country

c. Name, Country (*least restrictive*)

Third, we again use GPT to validate the matches generated in the three rounds of Orbis batch searches. When combining validated matches from all rounds, we manually resolve multiple

[4] The data processing steps are completely tractable on a public Github Repository (Link).

conflicting matches (only 16 instances). Ultimately, we can match 15,864 out of 17,954 EU ETS installations to firms in Orbis. Any remaining unmatched accountholders/installations are primarily due to changes in firm name (possibly because of reorganizations), non-firm entities (e.g., individuals or public institutions covered in the EU ETS) or limited Orbis coverage of private firms outside Europe.

Another important concern in our matching is that firm financials and emissions may not be measured at the same level. For instance, a multinational group company may have other foreign subsidiaries/installations outside the scope of the EU ETS for which we do not observe emissions, even though those subsidiaries contribute to the group's global consolidated financials. While the introduction of firm fixed effects partially addresses any time-invariant mismatch between emissions and financial data, we also seek a tighter match by using unconsolidated financials in Orbis, by limiting the sample to accountholders headquartered in countries covered by the EU or UK ETS, and by matching accountholders to subsidiaries in the same country rather than to the parent company, if possible.

Our final sample contains 74,506 firm-year observations on firms' emission intensities spanning primarily the period from 2005 to 2022. Our sample composition closely mirrors the scope of the EU ETS. It is largely comprised of firms in the manufacturing, electricity, transportation and mining sectors with more than half of our observations stemming from manufacturing.

References

Abrell, Jan. 2024. *Database for the European Union Transaction Log*. Working Paper.

Aswani, Jitendra, Aneesh Raghunandan, and Shiva Rajgopal. 2024a. "Are Carbon Emissions Associated with Stock Returns?" *Review of Finance* 28 (1): 75–106. https://doi.org/10.1093/rof/rfad013.

Aswani, Jitendra, Aneesh Raghunandan, and Shiva Rajgopal. 2024b. "Are Carbon Emissions Associated with Stock Returns?—Reply*." *Review of Finance* 28 (1): 111–15. https://doi.org/10.1093/rof/rfad020.

Atz, Ulrich, Tracy Van Holt, Zongyuan Zoe Liu, and Christopher C. Bruno. 2022. "Does Sustainability Generate Better Financial Performance? Review, Meta-Analysis, and Propositions." *Journal of Sustainable Finance & Investment* 13 (1): 802–25. https://doi.org/10.1080/20430795.2022.2106934.

Bénabou, Roland, and Jean Tirole. 2010. "Individual and Corporate Social Responsibility." *Economica* 77 (305): 1–19. https://doi.org/10.1111/j.1468-0335.2009.00843.x.

Berg, Florian, Julian F. Kölbel, and Roberto Rigobon. 2022. "Aggregate Confusion: The Divergence of ESG Ratings." *Review of Finance* 26 (6): 1315–44. https://doi.org/10.1093/rof/rfac033.

Bolton, Patrick, and Marcin Kacperczyk. 2024. "Are Carbon Emissions Associated with Stock Returns? Comment." *Review of Finance* 28 (1): 107–9. https://doi.org/10.1093/rof/rfad019.

Busch, Timo, Alexander Bassen, Stefan Lewandowski, and Franziska Sump. 2022. "Corporate Carbon and Financial Performance Revisited." *Organization & Environment* 35 (1): 154–71. https://doi.org/10.1177/1086026620935638.

Christensen, Hans B., Luzi Hail, and Christian Leuz. 2021. "Mandatory CSR and Sustainability Reporting: Economic Analysis and Literature Review." *Review of Accounting Studies* 26 (3): 1176–248. https://doi.org/10.1007/s11142-021-09609-5.

Colmer, Jonathan, Ralf Martin, Mirabelle Muûls, and Ulrich J. Wagner. 2025. "Does Pricing Carbon Mitigate Climate Change? Firm-Level Evidence from the European Union Emissions Trading System." *The Review of Economic Studies* 92 (3): 1625–60. https://doi.org/10.1093/restud/rdae055.

Dechezleprêtre, Antoine, Tomasz Kozluk, Tobias Kruse, Daniel Nachtigall, and Alain de Serres. 2019. "Do Environmental and Economic Performance Go Together? A Review of Micro-Level Empirical Evidence from the Past Decade or So." *International Review of Environmental and Resource Economics* 13 (1–2): 1–118. https://doi.org/10.1561/101.00000106.

Dechezleprêtre, Antoine, Daniel Nachtigall, and Frank Venmans. 2023. "The Joint Impact of the European Union Emissions Trading System on Carbon Emissions and Economic Performance." *Journal of Environmental Economics and Management* 118 (March): 102758. https://doi.org/10.1016/j.jeem.2022.102758.

Friede, Gunnar, Timo Busch, and Alexander and Bassen. 2015. "ESG and Financial Performance: Aggregated Evidence from More than 2000 Empirical Studies." *Journal of Sustainable Finance & Investment* 5 (4): 210–33. https://doi.org/10.1080/20430795.2015.1118917.

Greenstone, Michael, Christian Leuz, and Patricia Breuer. 2023. "Mandatory Disclosure Would Reveal Corporate Carbon Damages." *Science* 381 (6660): 837–40. https://doi.org/10.1126/science.add6815.

Jensen, Michael C. 2010. "Value Maximization, Stakeholder Theory, and the Corporate Objective Function." *Journal of Applied Corporate Finance* 22 (1): 32–42. https://doi.org/10.1111/j.1745-6622.2010.00259.x.

Lyubich, Eva, Joseph Shapiro, and Reed Walker. 2018. "Regulating Mismeasured Pollution: Implications of Firm Heterogeneity for Environmental Policy." *AEA Papers and Proceedings* 108 (May): 136–42. https://doi.org/10.1257/pandp.20181089.

Martin, Ralf, Mirabelle Muûls, and Ulrich J. Wagner. 2016. "The Impact of the European Union Emissions Trading Scheme on Regulated Firms: What Is the Evidence after Ten Years?" *Review of Environmental Economics and Policy* 10 (1): 129–48. https://doi.org/10.1093/reep/rev016.

Palmer, Karen, Wallace E. Oates, and Paul R. Portney. 1995. "Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?" *Journal of Economic Perspectives* 9 (4): 119–132.

Porter, Michael E., and Mark R. Kramer. 2011. "Creating Shared Value." *Harvard Business Review* 89 (1–2): 62–77.

Porter, Michael E., and Claas van der Linde. 1995. "Toward a New Conception of the Environment-Competitiveness Relationship." *Journal of Economic Perspectives* 9 (4): 97–118. https://doi.org/10.1257/jep.9.4.97.

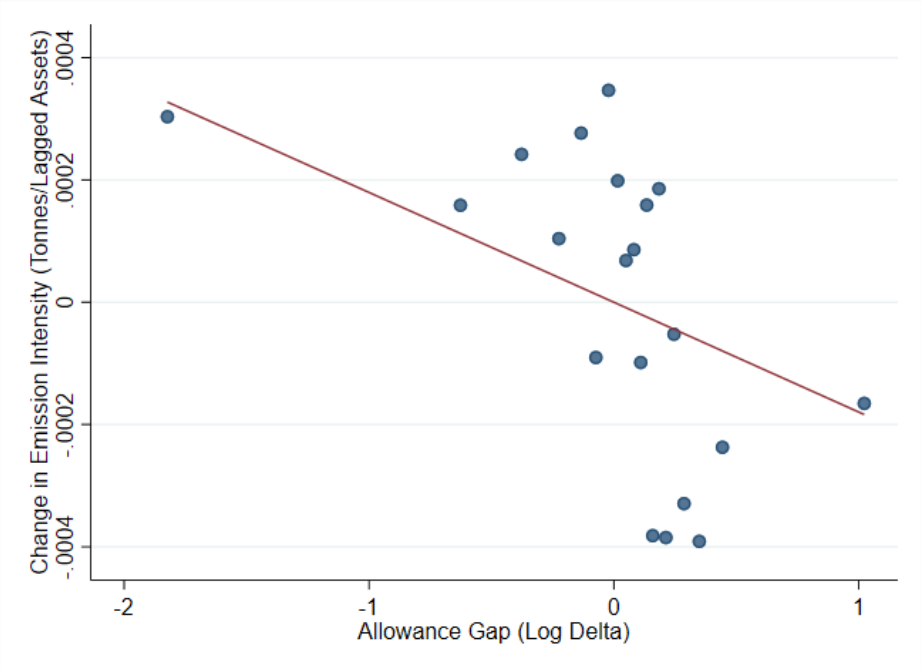
Sijm, Jos, Karsten Neuhoff, and Yihsu Chen. 2006. "CO2 Cost Pass-through and Windfall Profits in the Power Sector." *Climate Policy* 6 (1): 49–72. https://doi.org/10.1080/14693062.2006.9685588.

Venmans, Frank Maarten Jan. 2016. "The Effect of Allocation above Emissions and Price Uncertainty on Abatement Investments under the EU ETS." *Journal of Cleaner Production* 126 (July): 595–606. https://doi.org/10.1016/j.jclepro.2016.02.108.

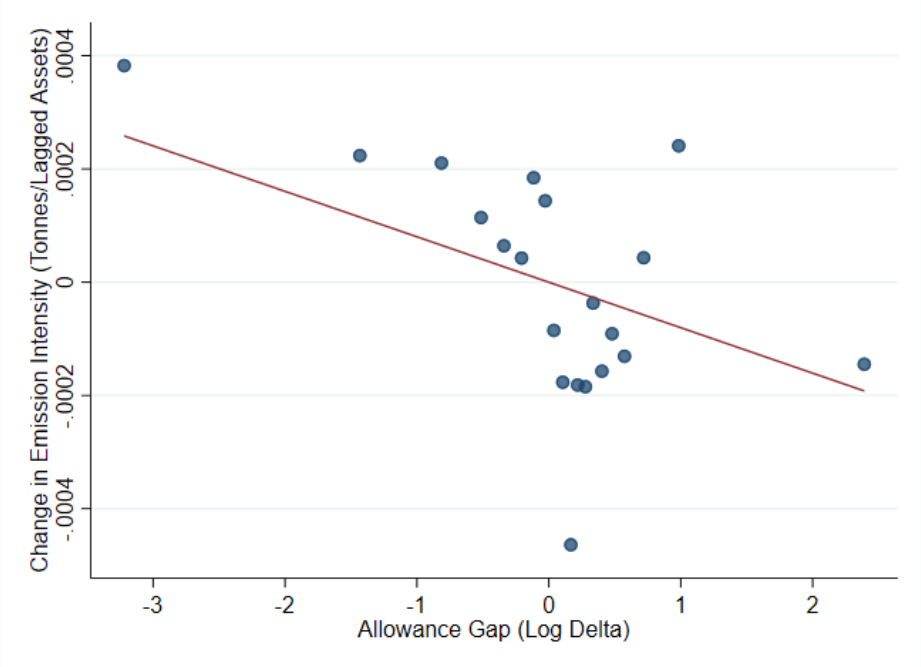
Zhang, Shaojun. 2024. "Carbon Returns across the Globe." *The Journal of Finance* 80 (1): 615–45. https://doi.org/10.1111/jofi.13402.

Figure 1 – Instrument Relevance – Changes in Emission Intensity and Carbon Allowance Shortfall

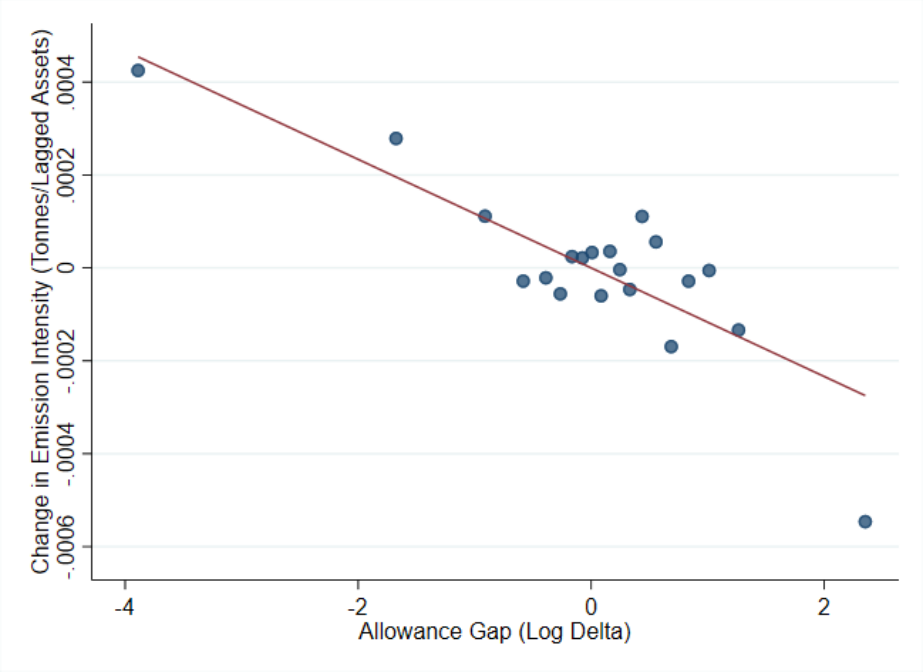
Panel A: Phase II



Panel B: Phase III

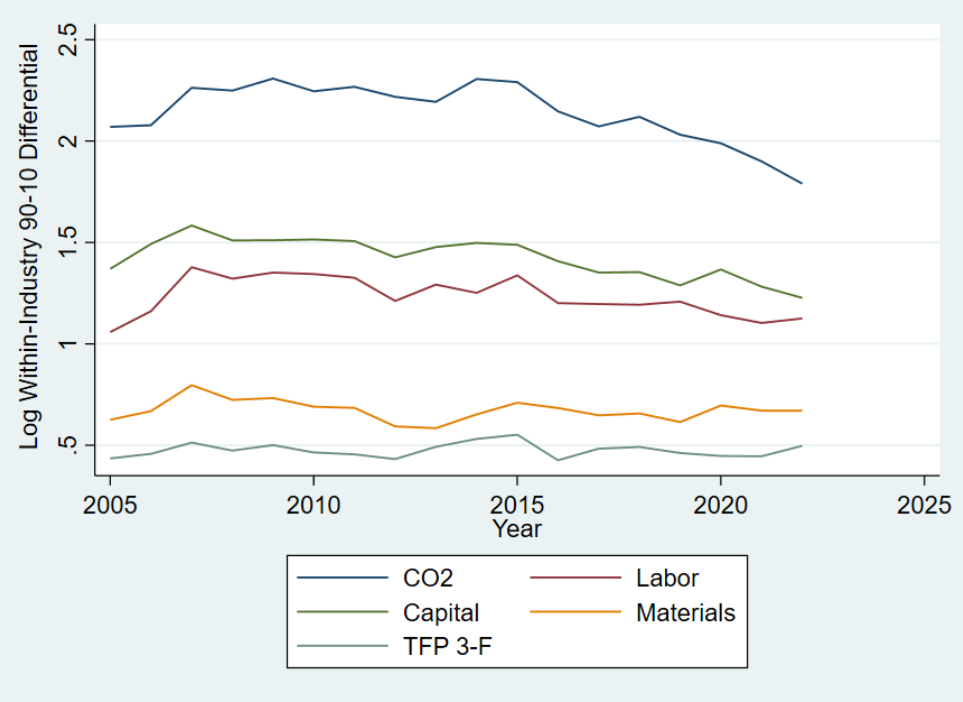


Panel C: Phase IV



The figure illustrates the relevance of carbon allowance shortfalls as an instrument for changes in emission intensity. We compute changes from beginning to end of each phase in the EU ETS and derive the carbon allowance shortfall at the beginning of each phase as: $Log(Emissions_{t-1}) - Log(Allocated\ Carbon\ Allowances_t)$. We residualize both variables by the firm-level controls from our baseline specification in Table 2 lagged by one year and de-mean by NACE sector fixed-effects. Each panel represents a scatterplot of 20 equal-sized bins of observations. Panel A, B and C restrict the sample to EU ETS Phase II, III and IV, respectively.

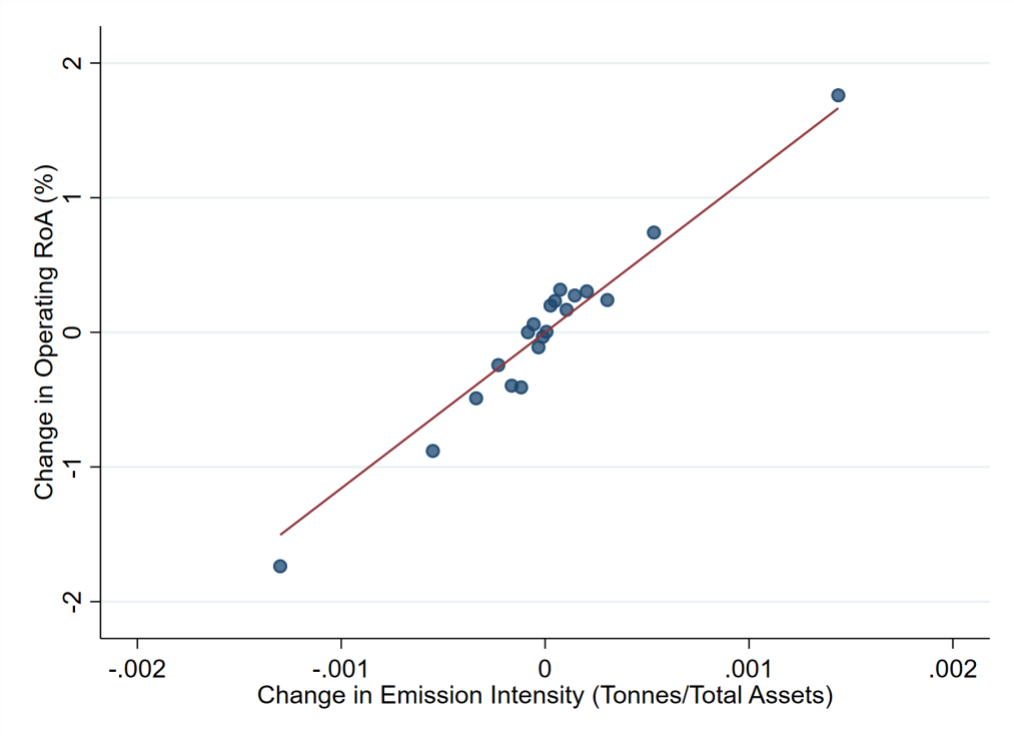
Figure 2 – Time-Series Trend in 90-10 Productivity Differentials – Manufacturing



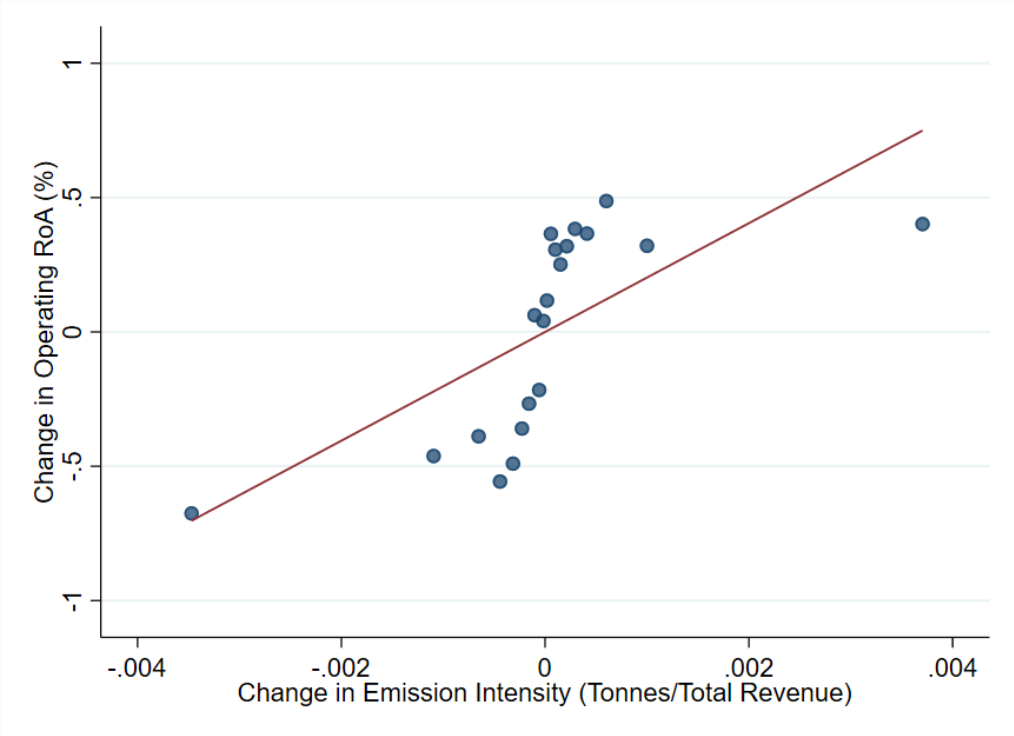
The figure illustrates the time-series trend of average 90-10 productivity differentials within granular NACE 4-digit industries in the manufacturing sector. We compute 90-10 productivity differentials within granular NACE 4-digit industries for several (quasi-) input factors. For example, *CO_2 Productivity* is defined as the logarithm of $\frac{Operating\ Revenue}{Carbon\ Emissions}$. The *Log 90-10 CO_2 Productivity Differential* is the difference between the 90th and 10th percentile in *CO_2 Productivity* within each NACE 4-digit industry. All other productivity factors are computed analogously, replacing *Carbon Emissions* by *Tangible Fixed Assets* (Capital), *No. of Employees* (Labor) and *Material Costs* (Materials). We exclude NACE 4-digit industries with fewer than 10 firms each year.

Figure 3 – Operating Profitability and Emission Intensity

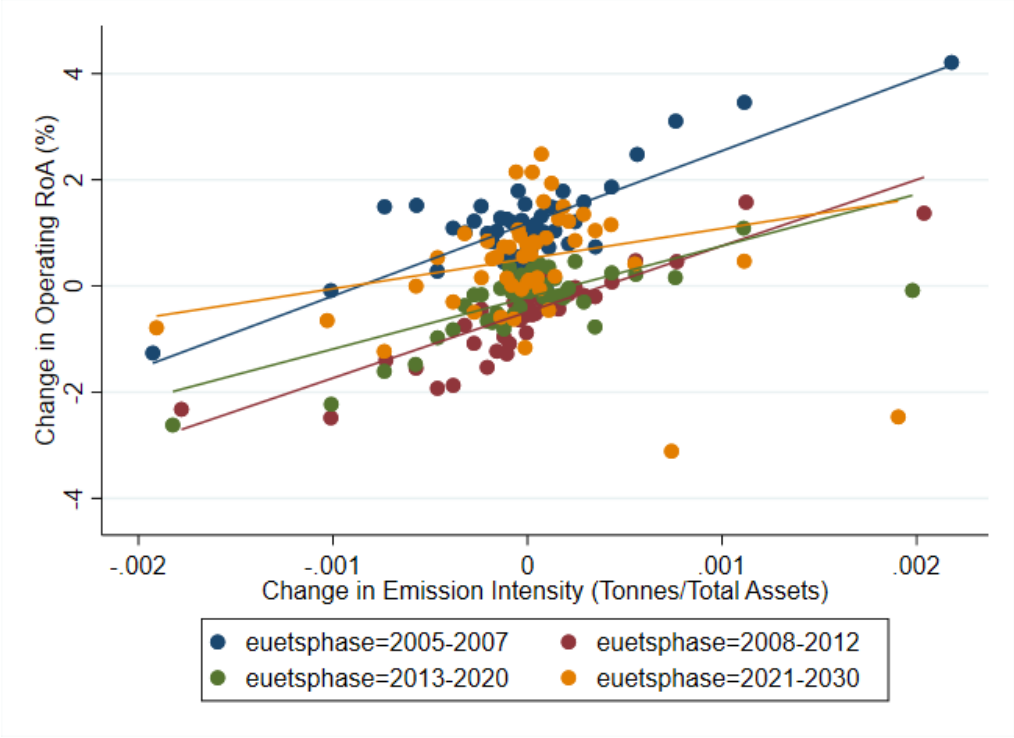
Panel A: Emissions scaled by Total Assets



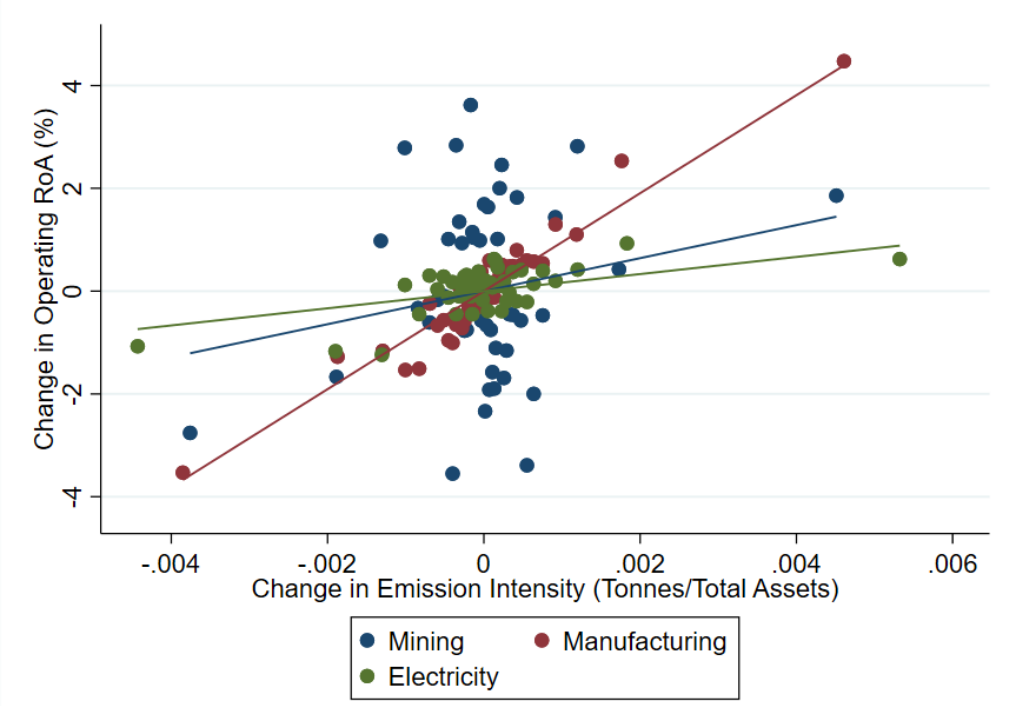
Panel B: Emissions scaled by Total Revenue



Panel C: Emissions scaled by Total Assets – By EU ETS Phase



Panel D: Emissions scaled by Total Assets – By Key Industries



The figure illustrates the relation between changes in operating RoA and changes in emission intensity. *Operating RoA* is defined as firm-level operating profits (from Orbis) over total assets. *Emission Intensity* are firm-level emissions (in tonnes) aggregated from installation-level compliance data in the EU ETS and scaled either by total assets (Panels A, C, D) or by operating revenues (Panel B). We residualize both variables by the firm-level controls from our baseline specification in Table 2. Each panel represents a scatterplot of equal-sized bins of observations restricted to observations between the 5th and 95th percentile of emission intensities. Panel A plots changes in emission intensity scaled by total assets on the x-axis, whereas emissions are scaled by operating revenues in Panel B. Panel C plots bins separately for each phase of the EU ETS. Panel D shows the relation separately for the three key industries.

Figure 4 – Time-Series Trend of EU ETS Carbon Allowance Prices



The figure illustrates the time-series trend of average monthly spot prices for carbon emission allowances under the EU ETS (in € per tonne of carbon emissions). We compute monthly averages from daily closing spot prices of EU ETS allowances (EUA) on the secondary emissions market (European Energy Exchange).

Table 1 – Descriptive Statistics for Scaled Emissions (kg/€ of Total Assets) by Firm-Level NACE Sector

NACE Sector	N	Mean	SD	p10	p25	Median	p75	p90
Agriculture, Forestry and Fishing	355	1.306	2.699	0.032	0.155	0.368	1.098	3.082
Mining and Quarrying	1785	1.446	2.634	0.026	0.079	0.235	1.661	4.546
Manufacturing	44549	0.978	2.053	0.026	0.104	0.335	0.895	2.442
Electricity, Gas, Steam and Air Conditioning Supply	19823	2.820	4.291	0.017	0.168	1.000	3.916	7.581
Water Supply; Sewerage, Waste Management and Remediation Activities	1064	1.010	2.373	0.004	0.023	0.168	0.856	2.770
Construction	673	1.187	3.105	0.009	0.025	0.110	0.730	3.273
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	1605	0.972	2.284	0.007	0.063	0.330	0.862	2.174
Transportation and Storage	2210	0.783	1.890	0.004	0.029	0.209	0.743	1.960
Information and Communication	192	0.100	0.335	0.000	0.001	0.001	0.011	0.236
Financial and Insurance Activities	186	0.846	1.275	0.001	0.047	0.338	1.017	3.327
Real Estate Activities	631	1.629	3.509	0.005	0.074	0.422	1.562	4.211
Professional, Scientific and Technical Activities	755	1.610	4.188	0.005	0.035	0.228	0.836	4.369
Administrative and Support Service Activities	565	1.463	3.909	0.003	0.014	0.101	1.035	4.218
Other Service Activities	113	3.172	6.955	0.014	0.225	0.502	1.824	5.236

Notes: This table presents summary statistics of firm-level emission intensity across NACE industry sectors. To compute emission intensities, we aggregate for each firm emissions verified for compliance with the EU ETS (in kg) across all firm installations and scale emissions by the firm's total assets. We truncate observations of emission intensity that are below the 1st or above the 99th percentile. Our sample excludes any NACE industry sectors with fewer than 100 observations across our sample period.

Table 2 – Operating Profitability and Emission Intensity (tonnes per € Assets)

Dep. Variable: Operating RoA (€/€ Total Assets x 100%)	(1)	(2)	(3)	(4)	(5)	(6)
Emission Intensity (t/€ Total Assets)	154.129*** (29.662)	324.456*** (42.480)	346.746*** (48.015)	328.226*** (48.217)	308.737*** (50.940)	292.503*** (49.324)
Log(Assets)	0.410*** (0.042)	1.064*** (0.168)	1.041*** (0.182)	1.273*** (0.185)	0.724*** (0.200)	1.291*** (0.185)
Tangible Assets Turnover			0.024*** (0.005)	0.022*** (0.005)	0.015*** (0.005)	0.022*** (0.005)
Financial Leverage				-5.519*** (0.386)	-5.571*** (0.414)	-5.758*** (0.396)
Sales Growth					5.259*** (0.183)	
Observations	72913	72913	70590	70022	61833	70011
Adj R^2	0.017	0.393	0.398	0.403	0.437	0.411
Firm FE	No	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No	Yes
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022

Notes: This table reports OLS coefficient estimates and (in parentheses) standard errors from regressions of operating return on assets on firm's emission intensities. *Operating RoA* is defined as firm-level operating profits (from Orbis) over total assets. *Emission Intensity* are firm-level emissions (in tonnes) aggregated from installation-level compliance data in the EU ETS and scaled by total assets. The firm-level controls for operating RoA are: *Log(Assets)*, *Tangible Asset Turnover* ($\frac{Operating\ Revenue}{Tangible\ Fixed\ Assets}$), *Financial Leverage* ($\frac{Long-Term\ Debt}{Total\ Assets}$) and *Sales Growth*. All continuous variables that are not logarithmized are trimmed at 1st and 99th percentile. Standard errors are clustered by firm and statistical significance is indicated by *** p<.01, ** p<.05, * p<.1

Table 3 – Operating Profitability and Emission Intensity – Robustness Tests
Panel A: Sensitivity to Emission Scaling

	Revenue Scaling			Unscaled (Log) Emissions		
Dep. Variable: Operating RoA (%)	(1)	(2)	(3)	(4)	(5)	(6)
Emission Intensity (t/€ Op. Revenue)	119.469***	91.158***	93.257***			
	(30.707)	(32.961)	(33.428)			
Log(Emissions)				0.668***	0.582***	0.189***
				(0.071)	(0.072)	(0.068)
Log(Op. Revenue)	4.333***	5.049***	6.492***			3.263***
	(0.164)	(0.178)	(0.215)			(0.191)
Log(Assets)			-3.265***	0.926***	0.668***	-1.904***
			(0.200)	(0.106)	(0.163)	(0.204)
Tangible Assets Turnover		0.018***	0.008*		0.022***	
		(0.005)	(0.005)		(0.005)	
Financial Leverage		-5.217***	-3.666***		-5.465***	-4.232***
		(0.374)	(0.381)		(0.381)	(0.375)
Observations	72507	69881	69881	74323	70972	73241
Adj R^2	0.427	0.441	0.450	0.393	0.401	0.424
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No	No
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022

Notes: This table reports OLS coefficient estimates and (in parentheses) standard errors from regressions of operating return on assets on firm's emission intensities. Panel A examines sensitivity of the relation to the choice of emission scalar and the decision to scale emissions. In the first three columns, we scale emissions by the firm's operating revenue (rather than its total assets) and include *Log(Operating Revenue)* as a control. In the last three columns, we replace scaled emission intensity by the unscaled logarithm of emissions (in tonnes). All other controls follow our baseline specification from Table 2 and are defined accordingly. Continuous variables that are not logarithmized are trimmed at 1st and 99th percentile. Standard errors are clustered by firm and statistical significance is indicated by *** p<.01, ** p<.05, * p<.1

Table 3 – Operating Profitability and Emission Intensity – Robustness Tests
Panel B: Adjustments for Carbon Allowances

Dep. Variable: Operating RoA (%)	(1)	(2)	(3)	(4)	RoA adj. for Allowances Sold
Emission Intensity	328.226***	272.239***	332.256***	309.131***	199.064***
(t/€ Total Assets)	(48.217)	(53.186)	(58.686)	(47.858)	(68.853)
Log(Allowances)		0.405***			
		(0.079)			
Log(Allowances sold)			0.115**		
			(0.052)		
Log(Excess Allowances)				-0.128***	
				(0.012)	
Observations	70022	65607	51858	70022	53372
Adj R^2	0.403	0.412	0.444	0.405	0.426
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022

Notes: This table reports OLS coefficient estimates and (in parentheses) standard errors from regressions of operating return on assets on firm's emission intensities. Panel B examines sensitivity of the relation to adjustments for windfall profits from sales of freely allocated carbon allowances. Columns (2)-(4) control for the number of yearly emission allowances allocated under EU ETS, the number of allowances sold or the number of allowances held in excess of actual emissions, respectively. Column (5) adjusts left-hand side operating profits for windfall profits from allowances sold by subtracting the value of allowances sold in each year. *Emission Intensity* and all control variables follow our baseline specification from Table 2 and are defined accordingly. Continuous variables that are not logarithmized are trimmed at 1st and 99th percentile. Standard errors are clustered by firm and statistical significance is indicated by *** p<.01, ** p<.05, * p<.1.

Table 4 – IV Approach for Emission Changes Instrumented by Carbon Allowance Shortfall

	Dependent Variable:					
	Δ_1Operating RoA (€/€ Total Assets$_t$)			Δ_1 CapEx Intensity (€/€ Total Assets$_{t-1}$)		
	OLS	First-Stage	2SLS	OLS	First-Stage	2SLS
Δ_1 Emission Intensity (t per Assets$_t$)	120.069*		1362.67***	-1180.86***		-2057.30***
	(67.279)		(366.723)	(105.76)		(534.292)
Allowance Gap: Log(Emissions$_{t-1}$) - Log(Allowance$_t$)		-0.006***			-0.005***	
		(0.000)			(0.000)	
Log(Assets)$_{t-1}$	-0.006	0.000***	-0.070***	-0.065***	0.000***	-0.027
	(0.011)	(0.000)	(0.021)	(0.015)	(0.000)	(0.023)
Tangible Assets Turnover$_{t-1}$	-0.004***	-0.000	-0.004**	0.020***	-0.000**	0.020***
	(0.002)	(0.000)	(0.002)	(0.003)	(0.000)	(0.003)
Financial Leverage$_{t-1}$	1.174***	0.0001	1.150***	-2.063***	0.0001***	-2.316***
	(0.141)	(0.000)	(0.165)	(0.222)	(0.000)	(0.245)
Observations	62071	58554	58554	50845	47800	47800
Adj R^2	0.001	0.020	-	0.013	0.016	-
F-stat Instrument	-	279.12	-	-	266.15	-
Firm FE	No	No	No	No	No	No
Industry Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	No	No	No	No
Year FE	No	No	No	No	No	No
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022

Notes: This table reports OLS as well as 2SLS-IV coefficient estimates and (in parentheses) standard errors from regressions of yearly changes in operating return on assets and CapEx intensity on yearly changes in firm's emission intensities. *Operating RoA* is defined as firm-level operating profits (from Orbis) over total assets in *t*. *CapEx Intensity* is computed as changes in tangible fixed assets plus depreciation and amortization scaled by lagged total assets in *t*-1. *Emission Intensity* are firm-level emissions (in tonnes) aggregated from installation-level compliance data in the EU ETS and scaled by total assets in *t*. We instrument yearly changes in emission intensity by the logarithm of carbon allowance shortfall relative to prior-year emissions, i.e.: $Log(Emissions_{t-1}) - Log(Allocated\ Carbon\ Allowances_t)$. For exposition, we divide this carbon allowance shortfall measure by 100. All control variables follow our baseline specification from Table 2, but are lagged by one year. All continuous variables that are not logarithmized are trimmed at 1st and 99th percentile. Standard errors are clustered by firm and statistical significance is indicated by *** p<.01, ** p<.05, * p<.1.

Table 5 – Operating Profitability and Emission Intensity – Mechanism: Investment Channel

	Dependent Variable:							
	Profitability Measures:				Investment Proxies:			
	EBIT Margin	EBIT Margin	EBITDA Margin	EBITDA Margin	Depreciation (% Sales$_t$)	Depreciation (% Sales$_t$)	CapEx Intensity (% Assets$_{t-1}$)	CapEx Intensity (% Assets$_{t-1}$)
Emission Intensity	254.426***	260.615***	128.915**	115.912*	-327.029***	-315.433***	-125.028***	-104.85**
(t/€ Total Assets)	(45.847)	(50.678)	(62.403)	(65.874)	(33.397)	(33.308)	(42.691)	(45.936)
Log(Assets)	2.646***	3.124***	3.904***	4.118***	0.350***	0.117	2.283***	2.190***
	(.208)	(.217)	(.263)	(.266)	(0.129)	(0.129)	(0.177)	(0.187)
Tangible Assets Turnover		.015***		-.002		-0.028***		-0.043***
		(.004)		(.005)		(0.003)		(0.005)
Financial Leverage		-4.764***		-2.757***		2.846***		1.160**
		(.493)		(.588)		(0.286)		(0.478)
Observations	71840	69442	66210	64521	66225	64886	59427	57920
Adj R^2	0.456	0.465	0.587	0.597	0.683	0.683	0.174	0.176
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No	No	No	No
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022

Notes: This table examines the investment channel underlying the relation between operating RoA and emission intensities. It reports OLS coefficient estimates and (in parentheses) standard errors from regressions of different profitability and investment proxies on firm's emission intensities. In the first four columns we replace operating RoA in the baseline specification from Table 2 with either *EBIT* or *EBITDA* margin (% of operating revenue) as the dependent variable. In the last four columns, we use *Depreciation* (% of operating revenue) and *CapEx* (% of prior-year total assets) as dependent variables. *CapEx Intensity* is computed as changes in tangible fixed assets plus depreciation and amortization scaled by lagged total assets in t-1. All controls follow our baseline specification from Table 2 and are defined accordingly. Continuous variables that are not logarithmized are trimmed at 1st and 99th percentile. Standard errors are clustered by firm and statistical significance is indicated by *** p<.01, ** p<.05, * p<.1.

Table 6 – Time Profile of Profitability-Emission Link
Panel A: Long-Run Differences

	Multi-Year Differences						
Dep. Variable: Δ_tOperating RoA (%)	1-Year	3-Year	3-Year	3-Year	5-Year	5-Year	5-Year
	Full	Full	No Overlap	No Overlap	Full	No Overlap	No Overlap
Δ_1Emission Intensity (t/€)	341.173***						
	(76.336)						
Δ_3Emission Intensity (t/€)		370.030***	457.479***	255.577***			
		(66.322)	(97.477)	(92.130)			
Δ_5Emission Intensity (t/€)					290.366***	276.032***	6.092
					(65.099)	(97.802)	(92.872)
Δ_tLog(Assets)	3.314***	1.471***	1.686***	-2.568***	0.932***	0.135	-3.787***
	(0.310)	(0.222)	(0.325)	(0.350)	(0.220)	(0.333)	(0.399)
Δ_tTangible Asset Turnover	0.028***	0.032***	0.026***	0.014**	0.026***	0.016*	0.007
	(0.006)	(0.006)	(0.008)	(0.007)	(0.006)	(0.009)	(0.010)
Δ_tFinancial Leverage	-4.917***	-5.455***	-5.346***	-3.596***	-5.337***	-5.475***	-3.663***
	(0.426)	(0.435)	(0.630)	(0.621)	(0.470)	(0.758)	(0.730)
Δ_tLog(Op. Revenue)				6.464***			5.920***
				(0.333)			(0.411)
Observations	61732	49900	16802	16802	39920	8884	8884
Adj R^2	0.026	0.033	0.038	0.106	0.027	0.012	0.098
Firm FE	No	No	No	No	No	No	No
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No	No	No
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022

Notes: This table examines the relation between corporate financial performance and emission intensities over longer horizons. Panel A reports OLS coefficient estimates and (in parentheses) standard errors from regressions of multi-year changes in operating RoA on multi-year changes in firm's emission intensities. In addition to the one-year changes in column (1), that correspond closely to our baseline specification in Table 2, we compute changes over 3-year and 5-year horizons in the remaining columns. We run these regressions in changes for both the full sample ("Full") and for a sample composed only of observations every 3 or 5 years, respectively ("No Overlap"). All controls are in changes over the same horizon but otherwise follow our baseline specification from Table 2 and are defined accordingly. Continuous variables that are not logarithmized are trimmed at 1st and 99th percentile. Standard errors are clustered by firm and statistical significance is indicated by *** p<.01, ** p<.05, * p<.1.

Table 6 – Time Profile of Profitability-Emission Link
Panel B: Tobin's q and Emission Intensity (tonnes per € Assets$_t$)

			EU ETS Phase		
Dep. Variable: Tobin's q_t / Op. RoA_t	I-III (Op. RoA)	I-IV (Tobin's q)	I 2005-2007 (Tobin's q)	II 2008-2012 (Tobin's q)	III-IV 2013-2030 (Tobin's q)
	(1)	(2)	(3)	(4)	(5)
Emission Intensity	675.295***	-8.299	516.703**	-22.900	-33.124**
(t/€ Total Assets$_t$)	(257.179)	(13.403)	(258.084)	(33.122)	(16.292)
Log(Assets)$_t$	1.695*	-.135**	.049	-.101	-.073
	(.998)	(.062)	(.308)	(.073)	(.117)
Financial Leverage$_t$	-3.908*	.012	-.146	.067	-.202
	(2.057)	(.11)	(.399)	(.114)	(.127)
Asset Growth$_t$	-	.158**	.143	.017	.023
	-	(.078)	(.113)	(.067)	(.087)
Industry q		.689***	.254	.855*	.538***
		(.169)	(.409)	(.461)	(.126)
Tangible Asset Turnover$_t$	0.016	-	-	-	-
	(0.010)	-	-	-	-
Observations	1949	2266	230	714	1302
Adj R^2	0.480	0.718	0.897	0.852	0.790
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022

Notes: This table examines the relation between corporate financial performance and emission intensities over longer horizons. Panel B reports OLS coefficient estimates and (in parentheses) standard errors from regressions of operating RoA and Tobin's q on firm's emission intensities. Column (1) replicates our baseline specification from Table 2, but for the sample of public firms for which we can compute Tobin's q. In Columns (2)-(5) we replace operating RoA with Tobin's q as the dependent variable. We compute Tobin's q following Doidge et al. (JFE, 2002) as: $\frac{Book\ Value\ of\ Total\ Assets - Book\ Value\ of\ Equity + Market\ Value\ of\ Equity}{Book\ Value\ of\ Total\ Assets}$, all denominated in USD. The firm-level controls for Tobin's q are: *Log(Assets)*, *Financial Leverage* ($\frac{Long-Term\ Debt}{Total\ Assets}$), *Asset Growth* and the average *Industry q*. Continuous variables that are not logarithmized are trimmed at 1st and 99th percentile. Standard errors are clustered by firm and statistical significance is indicated by *** p<.01, ** p<.05, * p<.1.

Table 7 – Cross-Sectional Heterogeneity of Profitability-Emission Link
Panel A: Heterogeneity by NACE Industry Sector

Dep. Variable: Operating RoA (%)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Emission Intensity	328.226***	165.331	862.515***	106.934*	184.281	725.567***	905.199	68.792
(t/€ Total Assets)	(48.217)	(370.927)	(92.174)	(55.441)	(997.134)	(237.274)	(869.029)	(301.687)
Log(Assets)	1.273***	1.654	1.529***	.918***	2.031	.799	-.49	.66
	(.185)	(1.361)	(.242)	(.32)	(1.314)	(1.283)	(1.246)	(.664)
Tangible Assets Turnover	.022***	-.029	.037***	.013	-.012	.009	0	.03*
	(.005)	(.02)	(.008)	(.008)	(.065)	(.019)	(.015)	(.016)
Financial Leverage	-5.519***	-7.563**	-6.467***	-3.792***	-4.626**	-3.977	-4.53*	-1.924
	(.386)	(3.057)	(.546)	(.605)	(2.278)	(2.762)	(2.425)	(1.456)
Observations	70022	1632	42710	18290	1002	1460	1810	2980
Adj R^2	0.403	0.327	0.429	0.380	0.597	0.426	0.395	0.393
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No	No	No	No
Sector	All	Mining	Manufact.	Electricity	Water & Waste Man.	Wholesale & Retail	Transpor-tation	Others

Notes: This table explores how the relation between operating profits and emission intensities varies in the cross-section. Panel A reports OLS coefficient estimates and (in parentheses) standard errors from regressions of operating return on assets on firm's emission intensities separately for each NACE industry sector. All controls follow our baseline specification from Table 2 and are defined accordingly. Continuous variables that are not logarithmized are trimmed at 1st and 99th percentile. Standard errors are clustered by firm and statistical significance is indicated by *** p<.01, ** p<.05, * p<.1.

Table 7 – Cross-Sectional Heterogeneity of Profitability-Emission Link
Panel B: Heterogeneity by CO_2 Productivity Differential

Dep. Variable: Operating RoA (%)	(1)	(2)	(3)	(4)
Emission Intensity (t/€ Total Assets)	917.731*** (116.724)	733.23*** (116.137)	353.497*** (118.194)	353.919*** (118.201)
Log 90-10 CO_2 Productivity Differential	.264*** (.089)	.28*** (.087)	.274*** (.082)	.282*** (.081)
Emission Intensity x 90-10 Prod. Differential	-136.571*** (27.244)	-100.5*** (26.695)	-62.893** (26.897)	-63.09** (26.912)
Log(Assets)	1.248*** (.205)	.636*** (.22)	-2.952*** (.264)	-2.954*** (.263)
Tangible Assets Turnover	.019*** (.005)	.01* (.006)	0 (.006)	0 (.006)
Financial Leverage	-5.516*** (.42)	-5.541*** (.448)	-3.974*** (.441)	-3.975*** (.441)
Sales Growth		5.112*** (.204)	3.472*** (.206)	3.474*** (.206)
Log(Op. Revenue)			5.872*** (.303)	5.869*** (.303)
Log 90-10 Capital Prod. Differential				-.067 (.104)
Observations	58143	51565	51565	51565
Adj R^2	0.403	0.437	0.470	0.470
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022

Notes: This table explores how the relation between operating profits and emission intensities varies in the cross-section. Panel B reports OLS coefficient estimates and (in parentheses) standard errors from regressions of operating return on assets on firm's emission intensities and its interaction with industry-level CO_2 productivity differentials. We compute 90-10 CO_2 productivity differentials within granular NACE 4-digit industries. *CO_2 Productivity* is defined as the logarithm of $\frac{Operating\ Revenue}{Carbon\ Emissions}$. The *Log 90-10 CO_2 Productivity Differential* is the difference between the 90th and 10th percentile in *CO_2 Productivity* within each NACE 4-digit industry. Controls largely follow our baseline specification from Table 2 with the addition of *Log 90-10 Capital Productivity Differential* in Column (4) where *Capital Productivity* is defined as $\frac{Operating\ Revenue}{Tangible\ Fixed\ Assets}$. Continuous variables that are not logarithmized are trimmed at 1st and 99th percentile. Standard errors are clustered by firm and statistical significance is indicated by *** p<.01, ** p<.05, * p<.1.

Table 8 –Time-Series Variation in Profitability-Emissions Link
Panel A: OLS Regressions by EU ETS Phase & Carbon Price

	EU ETS Phase				Interaction with Carbon Price			
Dep. Variable: Operating RoA (%)	I-IV	I & II 2005-2012	III 2013-2020	IV 2021-2030	Logged	Logged	Logged	Logged
Emission Intensity (t/€ Total Assets)	328.226*** (48.217)	444.039*** (80.764)	334.009*** (103.831)	-226.133 (405.332)	421.092*** (59.312)	368.677*** (61.392)	327.377*** (64.890)	331.146*** (65.489)
Emission Intensity x Carbon Price					-42.438*** (15.844)	-39.013** (16.804)	-32.126* (18.027)	-30.256* (17.589)
Log(Assets)	1.273*** (.185)	1.855*** (.35)	.87*** (.305)	7.833*** (1.161)	1.261*** (.185)	1.159*** (.189)	1.169*** (.189)	1.16*** (.19)
Tangible Assets Turnover	.022*** (.005)	.039*** (.009)	.024*** (.007)	.017 (.024)	.023*** (.005)	.023*** (.005)	.023*** (.005)	.023*** (.005)
Financial Leverage	-5.519*** (.386)	-5.446*** (.606)	-4.759*** (.621)	-11.641*** (2.176)	-5.526*** (.386)	-5.47*** (.387)	-5.708*** (.397)	-5.712*** (.397)
Observations	70022	27655	33672	7170	70022	69407	69396	69396
Adj R^2	0.403	0.463	0.518	0.488	.406	.415	.415	.406
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intensity x ETS Phase	No	No	No	No	No	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No	No	Yes	Yes
Linear Time Trend	No	No	No	No	No	No	No	Yes

Notes: This table explores how the relation between operating profits and emission intensities varies along the time-series and by the carbon price in the EU ETS. Panel A reports OLS coefficient estimates and (in parentheses) standard errors from regressions of operating RoA on firm's emission intensities by EU ETS Phase and interacted with the price for carbon allowances in the EU ETS secondary market. In the first four columns, we run the baseline specification from Table 2 separately for each EU ETS Phase, combining the first two phases since the allocation mechanism and number of carbon allowances was largely similar. In the last four columns we include an interaction between *Emission Intensity* and *Log Carbon Price* defined as the logarithm of the average yearly price for carbon allowances in EU ETS secondary market. All controls follow our baseline specification from Table 2 and are defined accordingly. Continuous variables that are not logarithmized are trimmed at 1st and 99th percentile. Standard errors are clustered by firm and statistical significance is indicated by *** p<.01, ** p<.05, * p<.1.

Table 8 – Time-Series Variation in Profitability-Emissions Link
Panel B: Phase-by-Phase Instrumental Variable Approach

Dep. Variable: Δ_t Operating RoA (€/€ Total Assets$_{t-1}$)	Multi-Year Differences (Beginning to End of Each Phase)							
	ETS Phase							
	All Phases		II 2008-2012		III 2013-2020		IV 2021-2030	
	First-Stage	2SLS	First-Stage	2SLS	First-Stage	2SLS	First-Stage	2SLS
Δ_t Emission Intensity (t per Assets$_{t-1}$)		-2.352		59.016**		43.841*		-21.835
		(13.200)		(24.864)		(25.407)		(14.759)
Allowance Gap: Log(Emissions$_{t-1}$) - Log(Allowance$_t$)	-0.0001***		-0.0002***		-0.0001***		-0.0001***	
	(0.000)		(0.000)		(0.000)		(0.000)	
Log(Assets)$_{t-1}$	0.000***	-0.003**	0.000***	-0.006*	0.000	-0.008***	0.000***	-0.006***
	(0.000)	(0.001)	(0.000)	(0.003)	(0.000)	(0.002)	(0.000)	(0.001)
Tangible Assets Turnover$_{t-1}$	0.000*	-0.000	0.000	-0.000	0.000	-0.0002*	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Financial Leverage$_{t-1}$	0.000	0.008	-0.0002	0.020	0.000	-0.003	0.000***	0.030**
	(0.000)	(0.006)	(0.000)	(0.016)	(0.000)	(0.013)	(0.000)	(0.014)
Observations	9397	9397	2983	2983	3174	3174	3240	3240
Adj R^2	0.033	-	0.024	-	0.040	-	0.062	-
F-stat Instrument	29.76	-	12.72	-	8.28	-	62.26	-
Firm FE	No	No	No	No	No	No	No	No
Industry Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No	No	No
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022

Notes: This table explores how the relation between operating profits and emission intensities varies along the time-series. Panel B reports 2SLS-IV coefficient estimates and (in parentheses) standard errors from regressions of changes in operating RoA on changes in firm's emission intensities over each EU ETS Phase. We compute changes from beginning to end of each phase in the EU ETS and instrument changes in emission intensity over each phase by the logarithm of carbon allowance shortfall at the beginning of each phase, defined as: $Log(Emissions_{t-1}) - Log(Allocated\ Carbon\ Allowances_t)$. All controls follow our baseline specification from Table 2, but are lagged by one year. Continuous variables that are not logarithmized are trimmed at 1st and 99th percentile. Standard errors are clustered by firm and statistical significance is indicated by *** p<.01, ** p<.05, * p<.1.

Table 9 – Operating Profitability and Air Pollutant Intensity (ex-CO_2) – E-PRTR Sample

Dep. Variable: Operating RoA (%)	(1)	(2)	(3)	(4)	(5)	(6)
Total Air (excl. CO) Pollutant Intensity (kg/€ Assets)	8.114	33.260***	20.170**			
	(6.138)	(8.836)	(8.400)			
Total Air (excl. CO) Pollutant Intensity (kg/€ Op. Revenue)				0.821	45.960***	29.780***
				(5.382)	(8.263)	(8.683)
Log(Assets)	0.052	1.868***	2.267***			
	(0.073)	(0.377)	(0.390)			
Log(Op. Revenue)				0.272***	5.254***	5.348***
				(0.078)	(0.437)	(0.458)
Tangible Assets Turnover	0.031**	0.089***	0.090***	0.028**	0.060***	0.061***
	(0.012)	(0.020)	(0.020)	(0.012)	(0.019)	(0.019)
Financial Leverage	-4.446***	-4.968***	-5.092***	-4.428***	-4.509***	-4.448***
	(0.641)	(0.869)	(0.868)	(0.641)	(0.886)	(0.890)
Observations	14209	13390	13390	14149	13332	13332
Adj R^2	0.009	0.440	0.461	0.012	0.474	0.494
Firm FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes
Country-Year FE	No	No	No	No	No	No

Notes: This table reports OLS coefficient estimates and (in parentheses) standard errors from regressions of operating return on assets on firm's total air pollutant intensity. *Operating RoA* is defined as firm-level operating profits (from Orbis) over total assets. *Air Pollutant Intensity* is the firm-level sum of all non-CO_2 air pollutants (in kg) reported in the European Pollutant Release and Transfer Register (E-PRTR) and scaled by either total assets or operating revenue. Based on our baseline specification in Table 2, the firm-level controls for operating RoA are: *Log(Assets)* or *Log(Operating Revenue)* depending on emission scalar, *Tangible Asset Turnover* ($\frac{Operating\ Revenue}{Tangible\ Fixed\ Assets}$) and *Financial Leverage* ($\frac{Long-Term\ Debt}{Total\ Assets}$). All continuous variables that are not logarithmized are trimmed at 1st and 99th percentile. Standard errors are clustered by firm and statistical significance is indicated by *** p<.01, ** p<.05, * p<.1

Online Appendix:
Corporate Emissions and Profits

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Table OA1 – Operating Profitability and Emission Intensity (kg per € Assets) – Manufacturing Firms

Dep. Variable: Operating RoA (%)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Emission Intensity (kg/€ Total Assets)	0.388***	0.838***	0.697***	0.881***	0.863***	0.766***	0.777***	0.411***
	(0.057)	(0.099)	(0.091)	(0.093)	(0.092)	(0.099)	(0.090)	(0.059)
Log(Assets)	0.496***	1.902***	1.398***	1.363***	1.532***	0.948***	1.495***	0.521***
	(0.059)	(0.221)	(0.227)	(0.241)	(0.243)	(0.259)	(0.244)	(0.059)
Tangible Assets Turnover				0.036***	0.035***	0.033***	0.032***	0.011
				(0.008)	(0.008)	(0.008)	(0.008)	(0.007)
Financial Leverage					-6.474***	-6.643***	-6.914***	-6.462***
					(0.546)	(0.583)	(0.551)	(0.515)
Sales Growth						6.499***		
						(0.263)		
Observations	43739	43739	43739	42875	42719	37824	42715	42871
Adj R^2	0.034	0.399	0.419	0.424	0.428	0.464	0.441	0.046
Firm FE	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Year FE	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No	No	Yes	No
Winsorization	1%	1%	1%	1%	1%	1%	1%	1%
Sample Restriction	Manufact.	Manufact.	Manufact.	Manufact.	Manufact.	Manufact.	Manufact.	Manufact.

Notes: Standard errors are in parentheses and clustered by firm *** p<.01, ** p<.05, * p<.1

Table OA2 – Operating Profitability and Emission Intensity (tonnes per € Assets) – Panel A: Lagged Asset Scalar & Controls

Dep. Variable: Operating RoA (€/€ Total Assets$_{t-1}$ x 100%)	(1)	(2)	(3)	(4)	(5)	(6)
Emission Intensity$_{t-1}$	167.343***	256.933***	278.397***	269.221***	242.144***	252.97***
(t/€ Total Assets$_{t-1}$)	(33.555)	(48.528)	(50.641)	(50.869)	(52.147)	(51.648)
Log(Assets)$_{t-1}$	.283***	-1.913***	-2.316***	-2.275***	-2.626***	-2.204***
	(.047)	(.213)	(.213)	(.217)	(.218)	(.22)
Tangible Assets Turnover$_{t-1}$			.013**	.012**	.01**	.013***
			(.005)	(.005)	(.005)	(.005)
Financial Leverage$_{t-1}$				-1.625***	-1.458***	-1.603***
				(.428)	(.425)	(.441)
Sales Growth$_{t-1}$					2.635***	
					(.181)	
Observations	57898	57898	56439	55953	55200	55935
Adj R^2	0.018	0.414	0.420	0.421	0.428	0.430
Firm FE	No	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No	Yes
Winsorization	1%	1%	1%	1%	1%	1%
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022

Notes: Standard errors are in parentheses and clustered by firm *** p<.01, ** p<.05, * p<.1

Table OA2 – Operating Profitability and Emission Intensity (tonnes per € Assets$_{t-1}$) – Panel B: Lagged Asset Scalar & Contemporaneous Controls

Dep. Variable: Operating RoA (€/€ Total Assets$_{t-1}$ x 100%)	(1)	(2)	(3)	(4)	(5)	(6)
Emission Intensity (t/€ Total Assets$_{t-1}$)	230.381***	595.943***	660.469***	640.202***	550.568***	608.488***
	(34.1)	(51.505)	(55.917)	(55.886)	(53.193)	(56.977)
Log(Assets)	.424***	1.721***	1.85***	2.095***	1.469***	2.135***
	(.046)	(.18)	(.196)	(.201)	(.209)	(.202)
Tangible Assets Turnover			.024***	.022***	.013**	.022***
			(.006)	(.006)	(.005)	(.006)
Financial Leverage				-5.846***	-5.832***	-6.146***
				(.433)	(.426)	(.444)
Sales Growth					6.337***	
					(.211)	
Observations	65000	65000	63253	62728	61842	62715
Adj R^2	0.021	0.400	0.405	0.409	0.439	0.418
Firm FE	No	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No	Yes
Winsorization	1%	1%	1%	1%	1%	1%
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022

Notes: Standard errors are in parentheses and clustered by firm *** p<.01, ** p<.05, * p<.1

Table OA3 – Operating Profitability and Emission Intensities by Ownership Structure

Dep. Variable: Operating RoA (%)	Full Sample	Shareholding Companies	No Firm Ownership	Full Sample	Shareholding Companies	No Firm Ownership
Emission Intensity (kg/€ Total Assets)	0.328***	0.333***	0.428***			
	(0.048)	(0.054)	(0.103)			
Emission Intensity (kg/€ Op. Revenue)				0.095***	0.113***	0.036
				(0.031)	(0.033)	(0.078)
Log(Assets)	1.266***	1.094***	3.894***			
	(0.184)	(0.189)	(0.713)			
Tangible Assets Turnover	0.021***	0.018***	0.062***	0.017***	0.014***	0.048***
	(0.005)	(0.005)	(0.017)	(0.005)	(0.005)	(0.017)
Financial Leverage	-5.515***	-5.453***	-6.587***	-5.213***	-5.266***	-4.566***
	(0.386)	(0.402)	(1.328)	(0.374)	(0.391)	(1.268)
Log(Op. Revenue)				5.031***	4.970***	6.181***
				(0.178)	(0.184)	(0.661)
Observations	70165	64080	6085	70020	63925	6095
Adj R^2	0.403	0.403	0.403	0.441	0.441	0.438
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No	No
Winsorization	1%	1%	1%	1%	1%	1%
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022

Notes: Standard errors are in parentheses and clustered by firm *** p<.01, ** p<.05, * p<.1

Table OA4 – Time Profile of Profitability-Emission Link – Panel A: Full Sample

Dep. Variable: Operating RoA (%)	(1)	(2)	(3)	(4)	(5)	(6)
Emission Intensity$_{t}$ (t/€)	328.226***					
	(48.217)					
Emission Intensity$_{t-1}$ (t/€)		282.489***				
		(44.696)				
Emission Intensity$_{t-2}$ (t/€))			210.366***			
			(41.555)			
Emission Intensity$_{t-3}$ (t/€))				118.894***		
				(42.633)		
Emission Intensity$_{t-4}$ (t/€))					120.525***	
					(39.902)	
Emission Intensity$_{t-5}$ (t/€))						55.700
						(40.165)
Observations	70022	62779	56721	51235	46076	41115
Adj R^2	0.403	0.414	0.426	0.440	0.449	0.454
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No	No
Winsorization	1%	1%	1%	1%	1%	1%
Sample Period most Firms	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022	2005-2022

Notes: Standard errors are in parentheses and clustered by firm *** p<.01, ** p<.05, * p<.1

Table OA4 – Time Profile of Profitability-Emission Link – Panel B: Fixed Sample excl. Phase IV

Dep. Variable: Operating RoA (%)	(1)	(2)	(3)	(4)	(5)	(6)
Emission Intensity$_t$ (kg/€)	0.242**					
	(0.098)					
Emission Intensity$_{t-1}$ (kg/€)		0.298***				
		(0.068)				
Emission Intensity$_{t-2}$ (kg/€))			0.236***			
			(0.068)			
Emission Intensity$_{t-3}$ (kg/€))				0.113*		
				(0.062)		
Emission Intensity$_{t-4}$ (kg/€))					0.079	
					(0.050)	
Emission Intensity$_{t-5}$ (kg/€))						0.061
						(0.040)
Observations	33625	33084	32909	32924	33050	33785
Adj R^2	.511	.513	.514	.513	.513	.511
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	No	No	No
Winsorization	1%	1%	1%	1%	1%	1%

Notes: Standard errors are in parentheses and clustered by firm *** p<.01, ** p<.05, * p<.1

Table OA5 – Operating Profitability (Adj. for Allowances sold) and Emission Intensity – By EU ETS Phase & Carbon Price

	EU ETS Phase				Interaction with Carbon Price			
Dep. Variable: Adj. Operating RoA (%)	I-IV	I & II 2005-2012	III 2013-2020	IV 2021-2030	Absolute	Absolute	Logged	Logged
Emission Intensity (kg/€ Total Assets)	0.197*** (0.070)	0.505*** (0.121)	0.259** (0.122)	No Transaction Data	0.554*** (0.077)	0.512*** (0.083)	0.472*** (0.072)	0.421*** (0.076)
Emission Intensity x Carbon Price					-0.029*** (0.003)	-0.029*** (0.003)	-0.143*** (0.015)	-0.151*** (0.015)
Log(Assets)	1.680*** (0.240)	3.46*** (0.442)	1.687*** (0.354)		1.659*** (0.241)	1.722*** (0.244)	1.637*** (0.240)	1.731*** (0.243)
Tangible Assets Turnover	0.024*** (0.007)	0.052*** (0.015)	0.016* (0.008)		0.025*** (0.007)	0.025*** (0.007)	0.025*** (0.007)	0.025*** (0.007)
Financial Leverage	-4.445*** (0.451)	-4.317*** (0.700)	-4.813*** (0.683)		-4.444*** (0.451)	-4.422*** (0.452)	-4.477*** (0.451)	-4.445*** (0.452)
Observations	53461	22627	30460	-	53461	53461	53461	53461
Adj R^2	0.427	0.466	0.497	-	0.431	0.431	0.429	0.429
Firm FE	Yes	Yes	Yes	-	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	-	Yes	Yes	Yes	Yes
Country-Year FE	No	No	No	-	No	No	No	No
Linear Time Trend	No	No	No	-	No	Yes	No	Yes
Winsorization	1%	1%	1%	-	1%	1%	1%	1%

Notes: Standard errors are in parentheses and clustered by firm *** p<.01, ** p<.05, * p<.1

Table OA6 – Operating Profitability and Air Pollutant Intensity – E-PRTR Sample – AIR (incl. Carbon)

Dep. Variable: Operating RoA (%)	(1)	(2)	(3)	(4)	(5)	(6)
Total Air Pollutant Intensity (kg/€ Assets)	0.062**	0.100**	0.103**			
	(0.028)	(0.044)	(0.041)			
Total Air Pollutant Intensity (kg/€ Op. Revenue)				0.025	0.150***	0.125***
				(0.022)	(0.047)	(0.047)
Log(Assets)	0.005	1.608***	2.214***			
	(0.070)	(0.356)	(0.377)			
Log(Op. Revenue)				0.260***	4.596***	4.788***
				(0.073)	(0.462)	(0.490)
Tangible Assets Turnover	0.029**	0.089***	0.092***	0.028**	0.060***	0.062***
	(0.012)	(0.019)	(0.019)	(0.012)	(0.018)	(0.018)
Financial Leverage	-4.404***	-4.681***	-4.789***	-4.439***	-4.211***	-4.094***
	(0.620)	(0.824)	(0.825)	(0.623)	(0.839)	(0.845)
Observations	14894	14048	14048	14866	14022	14022
Adj R^2	0.010	0.441	0.462	0.012	0.470	0.492
Firm FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes
Country-Year FE	No	No	No	No	No	No
Winsorization Total Air Pollutant Intensity	1%	1%	1%	1%	1%	1%

Notes: Standard errors are in parentheses and clustered by firm *** p<.01, ** p<.05, * p<.1

Table OA7 – Operating Profitability and Water Pollutant Intensity – E-PRTR Sample – WATER

Dep. Variable: Operating RoA (%)	(1)	(2)	(3)	(4)	(5)	(6)
Total Water Pollutant Intensity (kg/€ Assets)	-1.261	7.861**	8.012**			
	(2.721)	(3.470)	(3.672)			
Total Water Pollutant Intensity (kg/€ Op. Revenue)				0.158	2.608	3.042
				(1.408)	(4.123)	(3.877)
Log(Assets)	-0.071	1.894***	1.901***			
	(0.119)	(0.620)	(0.640)			
Log(Op. Revenue)				0.130	3.515***	3.452***
				(0.129)	(0.669)	(0.709)
Tangible Assets Turnover	0.017	0.071***	0.069***	0.018	0.063**	0.063**
	(0.013)	(0.025)	(0.024)	(0.013)	(0.026)	(0.026)
Financial Leverage	-1.074	-3.416**	-3.081*	-1.317	-2.243	-1.908
	(1.036)	(1.672)	(1.672)	(1.032)	(1.683)	(1.664)
Observations	5319	4899	4899	5321	4902	4902
Adj R^2	0.001	0.420	0.447	0.001	0.429	0.455
Firm FE	No	Yes	Yes	No	Yes	Yes
Year FE	No	No	Yes	No	No	Yes
Country-Year FE	No	No	No	No	No	No
Winsorization Total Water Pollutant Intensity	1%	1%	1%	1%	1%	1%

Notes: Standard errors are in parentheses and clustered by firm *** p<.01, ** p<.05, * p<.1

Figure OA1 – Trends in Emission Intensity across Industries

