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Do firms respond to commitments on climate change? Impact of COP21 on investment intensity

Pramendra Singh Tank*, Sanjay Kumar Jain†, and Balagopal Gopalakrishnan‡

Abstract

In the Paris Climate Agreement (COP21), countries pledged to restrict global warming to 1.5-2.0 degrees Celsius by reducing greenhouse gas (GHG) emissions. We examine whether firms respond to the commitments made by countries in the period following the agreement. Using cross-country data with 68,471 firm-year observations and a policy experiment approach, we find that manufacturing firms domiciled in countries with ex-ante higher GHG emissions per capita reduce their capital expenditure intensity after COP21. We also find that the market valuations of such firms are substantially depressed compared to those firms located in countries with low GHG emissions per capita. The findings suggest that climate policy uncertainty and transition risks have likely contributed to the heterogenous firm response across countries. The insights from our study contribute to a relatively novel literature that assesses the impact of the global climate agreement on capital expenditure intensity and market valuation.

Keywords: COP21; GHG emissions; Capex intensity; Climate change; Climate finance; Climate risk;

JEL classification: D81, G31, G32, G38, Q58

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1. Introduction

The Paris Agreement, also known as COP21, was a groundbreaking international accord committed to combating climate change (Falkner, 2016). Advanced and emerging market countries voluntarily pledged to reduce emissions to mitigate global warming by declaring their Nationally Determined Contributions (NDCs). The 'Pledge and Review' process adopted in the Paris Agreement oversees these declared commitments' implementation and provides a crucial disciplinary mechanism to enforce accountability against self-declared commitments (Jacquet & Jamieson, 2016). Consequently, commitments declared by countries will also percolate within a country to firms (Bolton & Kacperczyk, 2023), particularly to manufacturing firms that significantly contribute to the overall emissions of respective countries. As a result, the agreement's impact can manifest in several ways for firms. For example, some firms may find once-remunerative projects less appealing due to increased financing costs resulting from emission-curbing commitments or government-imposed carbon taxes. Some firms may adopt wait and approach in investments to deal with climate policy uncertainty in the wake of the Paris Agreement. Therefore, it is imperative to understand how firms respond individually to the Paris Agreement's ratification and the countries' commitments outlined in their First Nationally Determined Contributions (NDCs) to reduce GHG emissions within a specific timeframe. This paper investigates whether COP21 commitments have influenced firms' capital expenditure decisions during the post-COP21 period.

Firms acknowledge the impact of such agreements on day-to-day operations and future opportunities. For instance, American Airlines Groups mentioned in their 2016 Annual report that "While there is no express reference to aviation in this international agreement, to the extent the United States and other countries implement this agreement or impose other climate change regulations, either with respect to the aviation industry or with respect to related industries such as the aviation fuel industry, it could have an adverse direct or indirect effect on our business." Similarly, Exxon Mobil Corp cites Citigroup's 2015 estimates in their 2016 proxy statement, i.e., "Lessons learned from the stranding of assets via the recent fall in the oil price gives food for thought about what the impact of the introduction of carbon pricing (or similar measures from Paris COP21) on higher-cost fossil fuel reserves might be." In short, anecdotal evidence suggests that firms anticipate risks, opportunities, and uncertainties associated with COP21 agreements.

We argue that countries with high per capita GHG emissions are more likely to introduce stringent climate policies to achieve the target of the Paris Agreement. Historical trends of per capita GHG emissions as per Figure 1 suggest that the world's per capita GHG emissions have more or less remained the same in the last twenty years. But countries in North American Regions and Europe have reduced the per capita GHG emissions, and are gradually moving towards the world average. However, countries in East Asia and Pacific, South Asia, Latin America, North Africa, and Middles east have increased per capita GHG emissions and are moving towards the world average. We can see that the countries are moving towards some sort of convergence of per capita GHG emissions around the world average. Figure 2 shows the distribution of countries with high and low per capita GHG emissions based on per capita GHG emissions reported in 2014. A comparison of First Nationally Determined Contributions (NDCs) between countries with high and low per capita GHG emissions countries suggests that either the target of GHG emissions proposed to be reduced by countries with low per capita GHG emissions is less than the same proposed by countries with high per capita emissions or the timelines proposed by countries with low per capita GHG emissions to reduce GHG emissions is later than the same proposed by countries with high per capita emissions.

For example, the European Union proposed reducing total GHG emissions by at least 40% from the 1990 level by 2030. At the same time, Australia and the USA proposed reducing total GHG emissions by 26 to 28% from the 2005 level by 2030. China proposed reducing emission intensity by 60 to 65% from the 2005 level by 2030. On the other hand, targets laid down in the first NDCs by most of the countries with low per capita GHG emissions were relatively less stringent. For example, India proposed reducing emission intensity (not total emissions) only by 30 to 35% from the 2005 level by 2030. Mexico proposed reducing GHG emissions by 50% from the 2000 level by 2050. Indonesia proposed reducing GHG emissions unconditionally by 29% from business as usual scenario (not even historical level) by 2030. Thus the above analysis of NDCs submitted by signatory countries suggests that most countries with high per capita GHG emissions declared more stringent targets than low per capita emission countries. The difference in the stringency of targets submitted post the Paris Agreement would have signaled to firms operating in countries with high per capita GHG emissions about the possibility of climate policies to reduce emissions to meet the target laid down in NDCs. Therefore, it is pertinent to examine how manufacturing firms reacted in terms of capital expenditure in high per capita emission countries compared to firms in low per capita emission countries post-COP21 due to climate policy uncertainty and transition risks.

Literature on climate risks suggests that financial markets are already pricing transition risks due to climate policy uncertainty after the Paris Agreement. Exposure to the transition risk means that climate policies to reduce emissions are likely to negatively affect emission-intensive firms in terms of future growth and profitability, possibly leading to a proliferation of stranded assets. Past studies indicate that investors (both debt and equity) are demanding higher returns from firms exposed to the transition risk (Ardia, Bluteau, Boudt, & Inghelbrecht, 2022; Bolton & Kacperczyk, 2021b; Chava, 2014; Delis, De Greiff, & Ongena, 2019; Ehlers, Packer, & de Greiff, 2022; Faccini, Matin, & Skiadopoulos, 2022; Ivanov, Kruttli, & Watugala, 2022; Sautner, Van Lent, Vilkov, & Zhang, 2023b). Higher cost of capital for firms exposed to transition risk suggests uncertainty in future expected cashflows and profitability. Also, studies by De Angelis, Tankov, and Zerbib (2022); Ilhan, Sautner, and Vilkov (2021) suggest that climate policy uncertainty adversely affects the business environment of emission-intensive firms. Therefore, manufacturing firms are not likely to undertake or delay the capital expenditure, as future cashflows have turned riskier after the Paris Agreement.

Using a policy experiment approach, we examine the effect of the Paris Climate Agreement on changes to the capital investment intensity of firms domiciled in countries with higher ex-ante emissions than those with lower GHG emissions. We employ a large cross-country sample of firms from the manufacturing sector for this study. The sample covers 70 countries from both advanced and emerging markets. We use a difference-in-differences methodology to empirically identify whether policy commitments led to changes in the capex intensity of manufacturing firms.

The key findings of our study are as follows. First, we find that firms in countries with higher ex-ante per capita GHG emissions have significantly reduced their investment intensity in the post-COP21 period compared to those in countries with lower emissions. We find that the reduction in capital expenditure intensity by firms in countries with high GHG emissions per capita is economically estimated to be 0.021 units (9 percent of mean Capital expenditure intensity) higher than that of firms in countries with low GHG emissions per capita. This finding underscores the greater impact of COP21 on capital expenditure intensity for firms operating in countries with higher GHG emissions per capita. Moreover, we also examine the marginal year-on-year impact of COP21 on Capital expenditure intensity. We find that, post COP21, the reduction in capital expenditure intensity by firms in countries with high GHG emissions per capita is both immediate and persistent. The result suggests that firms promptly respond to COP21 by decreasing their capital expenditure intensity; moreover, the reduction is consistent throughout the years after COP21.

Second, we explore whether there is an impact on firm valuation and profitability if firms forego growth opportunities by reducing their capital expenditure. Using price to book value (PB Value) as a proxy for market valuation, we find that the reduction in PB value for firms in high GHG emissions per capita countries is economically estimated to be 0.306 units (13 percent of average PB value) compared to firms in low GHG emissions per capita countries in the post-COP21 period. Furthermore, we explore if this foregoing of growth opportunities, which act as a leading indicator, impacts the current profitability of firms. Contrary to the results obtained for PB value, the profitability results exhibit a positive trend and are marginally significant at the 10 percent level. The findings suggest that following COP21, firms in countries with high GHG emissions per capita demonstrate slightly higher profitability compared to firms in countries with low GHG emissions per capita. These results provide additional evidence supporting the notion that COP21 introduces uncertainty regarding future cash flow for firms in high-emission countries, consequently reducing their firm valuation. However, this does not significantly impact the current profitability from the existing assets of the firms.

Finally, we conduct heterogeneity tests to examine whether the differential reduction in capital expenditure intensity between countries with high and low GHG emissions per capita depends on the quality of institutions. As the concept of capital expenditure intensity is closely tied to financial and business freedom within countries, we specifically examine financial and business freedom. Utilizing data from the Index of Economic Freedom by the Heritage Foundation, we discover that the reduction in capital expenditure intensity is greater in countries with low financial and business freedom. In other words, countries with higher government interference experience a higher reduction in capital expenditure. Additionally, we incorporate a holistic measure of the quality of institutions used in the literature, i.e., OECD and non-OECD classifications (Kher, Yang, & Newbert, 2022). The result suggests a higher reduction in capital expenditure intensity in countries with weak institutions. This finding provides counter-intuitive evidence regarding the government's "grabbing hand" behavior in increasing compliance with country-level agreements (Shleifer & Vishny, 1998).

To ensure the robustness of our findings, we employed a comprehensive set of tests. First, we conducted standard parallel trend tests through visual inspection and coefficient plots. Second, we used a matching algorithm to mitigate potential biases arising from pre-treatment differences between firms in countries with high and low GHG emissions per capita. Third, we explored alternate specifications by incorporating continuous variables, specifically total GHG emissions per capita and total GHG emissions as independent variables. Fourth, we conducted a placebo estimation by artificially inducing a shock during a normal period.

Additionally, we conducted a firm-level analysis using Environmental scores (from ESG scores) to ensure that specific country-level trends do not influence the results. We tested whether the country-level findings related to higher enforcement pressure for firms in high GHG emission countries apply to firms with low environmental scores. The results suggest that firms with low environmental scores reduce their capital expenditure intensity after COP21, whereas firms with high environmental scores increase it. Thus, even the firm-level results align with the country-level results, providing further credibility to our findings. Overall, the robustness results largely support our baseline results, reinforcing their credibility.

We contribute to the literature on the real effects of climate agreements in the following ways. Firstly, to our knowledge, this is one of the first studies to examine the impact of the Paris Agreement on the real sector, specifically on the capital investment intensity of firms. Secondly, the study complements the recent literature on the potential channels through which the agreements can affect firm decisions (De Haas & Popov, 2023). Thirdly, the large cross-country sample employed in our study helps in better identification and provides external validity to our findings.

The rest of the paper is organized as follows. The next section discusses the conceptual background and formulates the hypotheses. The subsequent section details the data obtained and the empirical methodology for estimations. The following section discusses the findings and examines various channels through which the commitments affect firm outcomes. The penultimate section details the robustness checks we conducted to validate our baseline findings. The last section concludes with some policy insights that can be drawn from the study.

2. Conceptual background and hypothesis

As the Paris Agreement is a legally binding treaty, each signatory country is required to declare and implement targets laid down in the Nationally Determined Contributions (NDCs). The Paris Agreement supports the bottom-up approach to curb emissions and limit the temperature increase. Previous agreements supported the top-down approach wherein industrialized countries (Annex I countries as per UNFCCC) were asked to reduce pre-defined levels of GHG emissions (Harstad, 2023). However, as per the Paris Agreement, all the countries were asked to submit intended actions through Nationally Determined Contributions and indicate the probable year of reaching Net Zero Emissions. So if a country has signed and ratified the Paris Agreement and declared NDCs, it would indicate that the country would introduce policies to limit GHG emissions and meet the targets laid down in the NDCs. As governments will be held accountable under the Paris Agreement for not meeting their declared targets, governments are more likely to enforce climate policies stringently. Therefore, signing the Paris Agreement will signal to firms, investors, and other stakeholders in a country that the governments will introduce policies to limit GHG emissions and that fossil-fuel-based power generation firms and manufacturing firms will be asked to act on reducing GHG emissions. Studying how firms respond to global negotiations such as the Paris Agreement can be a crucial research agenda to explore and study further.

Prior research indicates that achieving targets in the Paris Agreement through NDCs has economic implications for households, communities, firms, banks, and financial markets. The literature on climate risk and asset pricing suggests that financial markets have started pricing climate risk in assets such as equities (Bolton & Kacperczyk, 2021a, 2021b; De Angelis et al., 2022; Nofsinger, Sulaeman, & Varma, 2019; Pástor, Stambaugh, & Taylor, 2022; Sautner, Van Lent, Vilkov, & Zhang, 2023a), debt (Acharya, Johnson, Sundaresan, & Tomunen, 2022; Chava, 2014; Correa, He, Herpfer, & Lel, 2022; Fard, Javadi, & Kim, 2020; Ivanov et al., 2022; Jiang, Li, & Qian, 2020; Seltzer, Starks, & Zhu, 2022), derivatives (Ilhan et al., 2021), mutual funds (Hartzmark & Sussman, 2019; Hsu, Li, & Tsou, 2023; Riedl & Smeets, 2017), real estate (Baldauf, Garlappi, & Yannelis, 2020; Bernstein, Gustafson, & Lewis, 2019; Eichholtz, Steiner, & Yönder, 2019; Giglio, Maggiori, Rao, Stroebel, & Weber, 2021), and municipal bonds (Goldsmith-Pinkham, Gustafson, Lewis, & Schwert, 2022; Painter, 2020).

Research suggests that firms are exposed to two types of climate risks: physical and transition risks. If financial markets are pricing physical risk, financial markets believe that future adverse climatic events can affect firms' performance and business environment (Acharya et al., 2022; Giglio, Kelly, & Stroebel, 2021). On the other hand, the pricing of transition risk indicates that policy interventions to support the green transition, technological innovations, and changes in preferences can affect fossil-fuel-based industries adversely (Acharya et al., 2023; Giglio, Kelly, & Stroebel, 2021). In this study, we primarily focus on the latter and study the impact of transition risk on firms' behavior, as a class of investors (institutional investors) believe that transition risk is more important in the short run compared to the physical risk (Krueger, Sautner, & Starks, 2020; Stroebel & Wurgler, 2021). Due to regulatory and policy interventions introduced to support the transition towards a low carbon economy could adversely affect fossil-fuel-based firms' financial viability, leading to the proliferation of stranded assets (Delis et al., 2019). On the other hand, firms engaged in businesses that support the green transition will benefit from policies and regulations brought to achieve the Paris Agreement.

Pricing of transition risk indicates that investors demand an additional premium on return from stocks of emission-intensive firms (Ardia et al., 2022; Bolton & Kacperczyk, 2021a; De Angelis et al., 2022; Hsu et al., 2023; Pástor et al., 2022; Sautner et al., 2023b), indicating higher future cashflow uncertainty. Additional risk premiums on the stocks would suggest that stocks of firms exposed to transition risk should trade at lower prices than firms not exposed to this risk. On the other hand, debt investor (both banks and bond investors) charges higher interest from firms exposed to climate risk (Chava, 2014; Fard et al., 2020; Ivanov et al., 2022; Seltzer et al., 2022). This channel of pricing of transition is mainly evident after the Paris Agreement. Evidence of pricing of transition risk indicates that firms exposed to this risk are getting riskier due to uncertainty about future cashflows and profitability.

Climate policy uncertainty also impacts transition risk. As the path of climate change and its probable adverse impact are uncertain (Barnett, 2023; Barnett, Brock, & Hansen, 2020), emission-intensive firms face increased climate policy uncertainty about the future business environment after the Paris Agreement (De Angelis et al., 2022; Ilhan et al., 2021) because it is difficult to gauge the timing, scope, and stringency of climate policies. The study by Dang, Gao, and Yu (2022) suggests that climate policy risk is also a factor in firms' financial decision-making. Due to the uncertainty at multiple levels and information asymmetry, financial markets find attaching probabilities to future adverse outcomes difficult. Under these circumstances, financial economics theory suggests that risk-averse investors demand a positive risk premium from firms exposed to the transition risk (De Angelis et al., 2022). Abrupt policy interventions can affect financial markets adversely due to the increased probability of systemic risk (Battiston, Mandel, Monasterolo, Schütze, & Visentin, 2017). Even as per NGFS[1], delayed and divergent climate policies will increase the transition risk. In a study on options markets, Ilhan et al. (2021) have shown that out-of-the-money put options of firms exposed to climate policy uncertainty are sold at a premium due to higher volatility and higher probability of left tail risk. Firms with higher adjustment costs to make the green transition will face greater risk from climate policy uncertainty, and such firms also witness higher costs of capital (Jiang et al., 2020). Institutional investors have recognized this risk and have already started engaging with firms to consider environmental considerations in the business strategy (Krueger et al., 2020; Stroebel & Wurgler, 2021).

In such a scenario, due to the uncertainty introduced by the Paris Agreement, it is likely that firms will ration capital investment to mitigate the impact of transition risk. There are mainly three reasons for firms to ration capital investment. First, after 2015, firms expect signatory countries to the Paris Agreement to enact multiple policies to reduce GHG emissions. Firms would want to wait and watch before making any investment (Noailly, Nowzohour, & van den Heuvel, 2022). Second, the technology required for low-carbon transition may not be readily available commercially; firms would want to wait for the technology to mature before making any capital investment. Third, an increase in the cost of capital for environmentally sensitive firms after the Paris Agreement will increase the hurdle rate for the management to decide on future investment opportunities. In all three scenarios, firms are expected to pass up capital investment in future growth opportunities. Therefore, it is important to study the effect of the Paris Agreement on the capital investment of firms, especially manufacturing firms.

As manufacturing firms primarily depend on fossil fuels, climate policy uncertainty is also expected to affect firms' capital investment intensity in high per capita emission countries after the Paris Agreement. Carbon markets similar to EU-ETS will impose

[1]See https://www.ngfs.net/ngfs-scenarios-portal/

an additional cost on manufacturing firms for each unit of emissions they produce. At the same time, subsidies to firms that are not dependent on fossil fuels will give a competitive advantage to these firms over firms that are dependent on fossil fuels. In this scenario, firms located in countries with high per capita GHG emissions are especially vulnerable because these countries are more likely to introduce stringent climate policies after the Paris Agreement. In a cross-country study, De Haas and Popov (2023) found that emission reduction is negatively impacted by stock market development in a country, as the stock market tries to direct investment towards less carbon-intensive sectors. Re-allocation of capital toward less carbon-intensive sectors would adversely affect opportunities for capital investment in carbon-intensive sectors, especially in the manufacturing sector after the Paris Agreement. Also, the hurdle rate for accepting capital investment would increase due to the increased cost of capital for manufacturing firms exposed to climate policy uncertainty in high-per capita emission countries. Therefore, manufacturing firms in high per capita emission countries are likely to decrease capital investments and consequently pass up future opportunities after the Paris Agreement.

As per the Q theory of investment (Tobin, 1969), the higher the market value relative to the replacement value, the firm must engage in higher investments to capture the growth opportunities. However, if the management believes that the investment may not improve growth prospects and expected future cash flows are risky, management would not undertake that investment (Froot, Scharfstein, & Stein, 1993). In this study, we posit that due to climate policy uncertainty, manufacturing firms with higher transition risk would desist from undertaking fossil-fuel-based or emission-intensive investments as future climate policies may penalize and adversely affect such firms' business prospects and future cash flows. The literature on transition risk suggests that the cost of capital for emission-intensive firms has increased, especially after the Paris Agreement, indicating future cash flow uncertainty. The study by Fazzari, Hubbard, Petersen, Blinder, and Poterba (1988) suggests that financial constraints such as high external finance costs affect investments negatively. Therefore, manufacturing firms might not undertake or delay the capital investment, especially in countries with high per capita GHG emissions where the government is expected to implement more stringent climate policies to reduce GHG emissions, leading to increased cash flow uncertainty and high cost of capital.

Although countries committed to reducing total emissions as per targets declared in NDCs, we believe that per capita emission is a better measure to understand the stringency of climate policies. From the equity perspective, per capita GHG emissions are expected to converge over the years to control the temperature (Meinshausen et al., 2022). Convergence of emissions means that countries with high per capita GHG emissions are expected to decrease emissions more than countries with low per capita GHG emissions. Climate change negotiations often revolve around the contentious issue of determining the primary responsibility for reducing emissions. The debate centers on whether this responsibility lies with countries that have historically emitted greenhouse gases and reached a certain level of development or with countries that are presently emitting high levels of GHGs while still in the process of development. By recognizing this distinction, UNFCCC categorized industrialized countries with high historical emissions as Annex I countries. These countries were given strict targets for the reduction of GHG emissions till the Kyoto Protocol. According to a study conducted by Meinshausen et al. (2022), the per capita greenhouse gas (GHG) emissions projections of countries that have ratified the Paris Agreement are influenced by the Nationally Determined Contributions (NDCs) they pledged. This indicates that countries with high per capita GHG emissions have committed to reducing their per capita GHG emissions in order to meet the targets specified in their NDCs, as suggested by (Zimm & Nakicenovic, 2020). Therefore, per capita emission is a valid measure to study the impact of COP21 on the investment intensity of firms in countries with high per capita GHG emissions compared to those in countries with low per capita GHG emissions.

We argue that climate policy uncertainty and transition risk may affect future cash flows and growth opportunities of manufacturing firms in countries with high per capita GHG emissions, consequently impacting capital expenditure decisions. Therefore, we hypothesize that:

Hypothesis 1 *After the Paris Agreement, firms in countries with high per capita GHG* *emissions reduced capital expenditure intensity compared to those in countries with high per capita GHG emissions.*

There are two channels at play here. First, firms are expected to reduce emissions due to commitments made by high per capita emission countries. Prior literature suggests that firm-level GHG emissions are negatively correlated with the market valuation of firms (Choi & Luo, 2021; Clarkson, Li, Pinnuck, & Richardson, 2015; Ott & Schiemann, 2023). These studies suggest that if manufacturing firms in high per capita emission countries are finding it difficult to reduce emissions after COP21 due to high transition costs, the valuation of such firms should go down due to the possibility of carbon taxes and climate policies supporting environment-friendly firms. Second, firms are forced to pass up investment opportunities due to higher climate policy uncertainty. We further argue that as a consequence of reduced capital expenditure intensity, the valuation of firms in high per capita emission countries should get adversely affected compared to firms in low per capita emission countries. Due to underinvestment by manufacturing firms in high per capita emission countries, future growth opportunities will be limited, leading to reduced growth in cashflows. Hence, we hypothesize that:

Hypothesis 2a *After the Paris Agreement, manufacturing firms located in countries with higher per capita GHG emissions have a higher impact on their market valuation compared to those located in countries with lower emissions.*

If a firm's valuation is negatively affected, assessing its impact on current profitability becomes crucial. Both current profitability, cash flow growth, and risk are factors that affect the valuation of a firm. If there is no significant impact on current profitability, it may suggest that the lack of growth in cashflows and the cashflow risks are the primary drivers leading to the decline in the valuation of firms in high-emission countries. Therefore, we hypothesize that:

Hypothesis 2b *After the Paris Agreement, the profitability of firms located in countries with high per capita GHG emissions should decline compared to firms located in countries with low per capita GHG emissions*

3. Data and Methodology

3.1. Data

We obtained firm financial data from the Worldscope Fundamentals database, provided by Refinitiv, covering the period from 2012 to 2019. The Worldscope database offers comprehensive coverage of data from over 120 countries, comprising information on 98,000 companies [2]. Previous studies utilize firms' financial data sourced from Worldscope to examine firm-level outcomes such as dividend policies (La Porta, Lopez-de Silanes, Shleifer, & Vishny, 2000), credit access during crisis episodes (Levine, Lin, & Xie, 2018), and adoption of IFRS (Nobes & Stadler, 2023). We also restrict our analysis to manufacturing firms, considering prior research that argues manufacturing firms bear significant costs in adopting environmentally friendly practices (Tzouvanas, Kizys, Chatziantoniou, & Sagitova, 2020; Wagner, 2005). To select manufacturing firms, we choose firms with a two-digit SIC code between 19 and 40. Furthermore, to obtain country-level data such as GHG emissions per capita, Total GHG emissions, GDP, and GDP growth, we combine the data from Worldscope fundamentals with World Bank and Climate Watch data. Subsequently, we also lag independent variables in the study to control for simultaneity. We also restrict the sample to firms with positive valuation, i.e., PB value greater than zero. After combining Worldscope and World Bank data, and lagging independent variables, our final sample comprises 11,853 unique firms from 70 countries with 68,741 firm-year observations. Table 1 and Table 2 show the industry and country-level break-up of firm-year observations in the sample, respectively.

We utilize Capital expenditure intensity (referred to as CAPEX intensity) as the response variable. CAPEX intensity is calculated as the current year's Capital expenditures (additions to fixed assets) ratio to the previous year's assets, specifically Net property, plant, and equipment. Our key explanatory variables are GHG emissions per capita and the COP21 dummy. GHG emissions per capita is a country-level variable measured

[2] https://www.refinitiv.com/en/financial-data/company-data/fundamentals-data/worldscope-fundamentals

in CO2 equivalent (metric tonnes) of GHG emissions per capita. The COP21 dummy variable represents the years before and after the Paris climate agreement, taking the value 1 for the year 2016 and onward and 0 otherwise. We also control for firm-level and country-level variables that may influence this relationship to assess the impact of GHG emissions per capita and COP21 on CAPEX intensity. Detailed descriptions, units, and data sources for each variable are provided in Table 3.

Table 4 shows the descriptive statistics of the variables. Total number of firm-year observations is 68,741 for the period 2012 to 2019. During the period under the study, the mean of capital expenditure intensity was 0.23 (23%), and the simple mean of per capita GHG emissions was 9.649 tonne CO2 equivalent. The mean of cashflows and EBITDA was 0.049 (4.9%) and 0.024 (2.4%), respectively. The Mean of PB ratios was 2.677, indicating the market is positive about future growth opportunities of manufacturing firms. The mean of the z-score was 3.869, indicating a low risk of bankruptcy overall. The simple mean of GDP growth in countries included in the sample was 4.021%. The mean value of the financial and investment freedom index of the countries included in the sample was 53.383 and 52.909, respectively.

3.2. Methodology

We employ a policy experiment approach to examine the effect of the Paris Climate Agreement on capital expenditure. The agreement is treated as an experimental intervention, with firms in countries characterized by high per capita GHG emissions forming the "treatment" group, while firms in countries with low per capita GHG emissions serve as the "control" group. Using a standard difference-in-differences (DID) model, we estimate the resulting impact on capital expenditure since adopting the Paris Climate Agreement. This analytical approach is well-suited to capture causal relationships by comparing changes over time between the treatment and control groups. The equation for the standard DID model is presented as follows:

$$CAPEX_{i,t} = \beta_0 + \beta_1 COP21_j + \beta_2 GHGpercapitahigh + \beta_3(COP21_j \times GHGpercapitahigh) + \beta_4 Z_{i,t-1} + \delta_i + \gamma_{j,t} + \epsilon_{i,t} \tag{1}$$

In this equation, $CAPEX_{it}$ represents the outcome variable, i.e., Capital expenditure intensity of firm i at time t. β_0 is the intercept term, β_3 measures the average treatment effect, β_1 represents the average time effect, and $\epsilon_{i,t}$ accounts for the error term. *GHG per capita High* is a binary variable that equals 1 for firms in the countries with high GHG emissions per capita (treatment group) and 0 for firms in the countries with low GHG emissions per capita, while COP21 is a binary variable indicating the post-treatment period (1 for years after the Paris Climate Agreement, 0 otherwise). Z is a set of control variables that include Cashflow, price-to-book ratio, EBITDA, and Z-score. In some specifications, we also control for the country-level variables, GDP and GDP Growth. Moreover, we add various fixed effects to the model to control for unobserved heterogeneity. We use time, firm-, country-, and industry-fixed effects to control for time-invariant, firm-invariant, country-invariant, and industry-invariant heterogeneity, respectively. Although firm-level fixed effects (shown as δ_i) subsume the country-, industry- and firm-level time-invariant heterogeneity, we have shown each of them separately in the tables for clarity. Furthermore, to control for industry-specific trends, we use interactive fixed effects ($\gamma_{j,t}$), i.e., the interaction of industry-fixed effects and time-fixed effects (Industry fixed-effects $\times$ Time-fixed effects). We use the linear model with high-dimensional fixed effects in STATA to control for interactive fixed effects (Correia, 2016).

4. Results and Analysis

4.1. Impact of COP21 on CAPEX Intensity

In this section, we estimate Equation 1 and discuss the findings. The baseline results are presented in Table 5, with each subsequent column incrementally incorporating additional controls and fixed effects. In column (1), we report the baseline result without including any control variables. Moving on to column (2), we introduce firm-level control variables. In column (3), we further incorporate firm- and country-level control variables. Finally, in column (4), we present the results of the specification outlined in Equation 1. This specification includes firm- and country-level control variables and interactive fixed effects. We will use this specification in column (4) for interpretation.

The interaction term between *COP21* and *GHG per capita high* captures the impact of COP21 on the capital expenditure intensity of firms in countries with high and low GHG emissions per capita. The coefficient of this interaction term is negative and significant in all the columns, suggesting that the reduction in capital expenditure intensity by firms in countries with high GHG emissions per capita is greater than in countries with low GHG emissions per capita.

Economically, the reduction in capital expenditure intensity by firms in countries with high GHG emissions per capita is estimated to be 0.018 units (8 percent of mean capital expenditure intensity) higher than that of firms in countries with low GHG emissions per capita. This finding underscores the greater impact of COP21 on capital expenditure intensity for firms operating in countries with higher GHG emissions per capita.

Moreover, the coefficients of the control variables in column (4) align with our expectations. For instance, the positive and significant coefficient of *PB value* supports the Q-theory of investments (Tobin, 1969). Additionally, the positive coefficient of the *Z-score* indicates that firms with lower bankruptcy risk tend to undertake more capital expenditure, further validating the results. Similarly, the coefficients of the country-level control variables are in-line with expectations. The coefficients of country-level control variables reveal that firms in developed countries with high *GDP* exhibit low capital expenditure intensity, whereas firms in developing countries with high *GDP growth* demonstrate high capital expenditure.

4.2. Parallel Trend test

Difference-in-differences (DID) methods rely on the crucial assumption of parallel trends between two groups during the pre-treatment period. DID assumes that the groups would have followed similar trends over time in the absence of treatment. Establishing parallel trends allows attributing any observed differences in outcomes following the treatment to the treatment itself. To ensure the validity of the DID approach, the consistency of pre-treatment differences between the groups needs examination. Two approaches have been suggested in previous empirical studies to test this assumption (Bailey & Goodman-Bacon, 2015; D'Acunto, Liu, Pflueger, & Weber, 2018).

The first approach involves visually inspecting the trends of the two groups before the treatment. In Figure 3, we plot the raw means trend of capital expenditure intensity for firms in countries with high and low GHG emissions per capita. The plot demonstrates that the difference between the capital expenditure intensity of firms in countries with high and low GHG emissions per capita remains approximately constant throughout the pre-treatment period, providing visual evidence suggesting a parallel trend during the pre-COP21 period. However, visual inspection alone cannot determine the statistical significance of this parallel trend.

To empirically test the parallel trend assumption, we employ the second approach, known as the coefficient plot. Figure 4 shows year-on-year differences in capital expenditure intensity for firms in high GHG emissions per capita countries (treatment group) and low GHG emissions per capita countries (control group) relative to the reference year 2012. The plot incorporates controls and fixed effects from baseline regressions. Before COP21, the capital expenditure intensity difference between high and low GHG emissions per capita firms was statistically insignificant, supporting the parallel trend assumption. Moreover, the plot suggests that post-COP21, firms in high GHG emissions per capita countries reduced their capital expenditure intensity more than firms in low GHG emissions per capita countries, relative to the year 2012 (at least for years 2016 and 2018). The plot primarily justifies the parallel trend assumption by highlighting statistically insignificant pre-treatment (pre-COP21) differences.

4.3. Heterogeneity

This section explores whether COP21's differential impact on countries with high and low GHG emissions per capita varies with other country-level factors. Specifically, we analyze three country-level factors: financial freedom, investment freedom, and development indicator (OECD).

Firms' capital expenditure intensity is closely tied to a country's financial and investment freedom. We predict that COP21 agreements will have a greater differential impact on countries with higher governmental interventions (or lower freedom from intervention). Financial freedom serves as an indicator of banking efficiency and independence from government control and interference in the financial sector (*Index of Economic Freedom*, 2023, p.411). Similarly, investment freedom assesses various regulatory restrictions imposed on investments (*Index of Economic Freedom*, 2023, p.411), including national treatment of foreign investment, foreign investment code, restriction on land ownership, sectoral investment restriction, expropriation of investments without fair compensation, foreign exchange controls, and capital controls. Consequently, when financial and investment freedom is low, the government can enforce agreements through intervention. Therefore, we expect a significantly higher differential impact of COP21 on countries with high and low GHG emissions per capita when financial and investment freedom is low.

We further categorize countries based on their institutional strength, classifying them as either having strong institutions (Organisation for Economic Co-operation and Development - OECD countries) or weak institutions (non-OECD countries). This classification, utilized as an indicator of institutional quality in previous studies (Kher et al., 2022), allows us to investigate the heterogeneity associated with institutional differences. We expect that in countries with weak institutions (non-OECD countries), firms will experience a greater reduction in capital expenditure intensity compared to countries with strong institutions (OECD countries). This differential reduction can be attributed to higher governmental intervention in countries with weak institutions.

We conduct the subsample analysis in Table 6 to examine these heterogeneities. Column (1) and column (2) display samples with low and high financial freedom, respectively. Column (3) and column (4) present samples with low and high investment freedom, respectively. Column (5) and column (6) show samples from non-OECD and OECD countries, respectively. The coefficient of interaction between *GHG per capita high* and *COP21* is negative in columns (1), column (3), and column (5), indicating that the higher differential impact occurs when financial freedom is low, investment freedom is low, and institutions are weak. In other words, the differential impact is greater when government intervention is high.

Overall, the heterogeneity results indicate that countries with low investment and business freedom experience a higher reduction in capital expenditure after COP21. This finding presents counter-intuitive evidence concerning the government's "grabbing hand" behavior in increasing compliance with country-level agreements (Shleifer & Vishny, 1998).

4.4. Marginal impact

From a policy perspective, understanding the transmission of macro-policies, such as country-level agreements, to micro-agents, such as firms, is crucial. This understanding is important because the time taken by firms to respond to country-level agreements can provide insights into future policies and subsequent expectations. For instance, if firms require significant time to respond to climate agreements and contribute to Nationally Determined Contributions (NDCs), countries can delve into the challenges faced by these firms and take appropriate actions to address these issues. Moreover, it can inform policymakers in tailoring future policies accordingly.

To assess the year-on-year impact of policies on capital expenditure intensity, we incorporate the separate year dummies for years following the COP21 agreements into the baseline results presented in Table 5. In Table 7, we present the marginal year-on-year impact of COP21 on the capital expenditure intensity of firms. Similar to the baseline, we progressively include controls and fixed effects in the model from column (1) to column (4). We refer to column (4) of Table 7 for interpretation.

The results are consistent with the baseline findings, indicating that the reduction in capital expenditure intensity among firms in countries with high GHG emissions per capita is greater than the reduction observed in countries with low GHG emissions per capita. Furthermore, this reduction is both immediate and persistent. The immediacy of the impact is supported by the negative and significant coefficient of GHG emissions per capita high and Year 2016, suggesting that firms promptly respond to COP21 by decreasing their capital expenditure intensity. Additionally, the persistence of the impact is indicated by the significant and negative coefficient of the interaction between GHG emissions per capita high and Year dummies (2017, 2018, and 2019), demonstrating a consistent reduction in capital expenditure intensity throughout the years after COP21.

In the next section, we look at the mechanisms underlying the reduction in Capital expenditure intensity post-COP21.

4.5. Impact on firm valuation

Climate agreements like COP21, which aim to reduce GHG emissions and promote the transition to green energy, are crucial in combating climate change. However, they introduce risks for firms that rely on fossil fuels because the transition process involves uncertainties related to internal and external changes. Internal changes encompass technological and process adjustments, while external changes involve regulatory shifts and evolving consumer expectations. These changes are inherently uncertain, leading to what is known as transition risk.

Transition risk, heightened by climate agreements like COP21, poses challenges for manufacturing firms (Tzouvanas et al., 2020; Wagner, 2005). The increased transition risk prompts firms to forego growth opportunities that would have been feasible in the absence of such climate agreements. For example, firms would withhold investments in carbon-intensive manufacturing plants, fearing backlash from customers or national governments.

Moreover, firms in countries with high GHG emissions per capita are expected to exhibit a greater propensity to forego growth opportunities compared to firms in countries with lower GHG emissions per capita. This decision to forego growth opportunities is likely reflected in a firm's valuation.

To assess these effects, we employ the price-to-book (PB) value as a measure of firm valuation and test hypothesis 2a, which predicts varying reductions in PB value between firms in countries with high per capita GHG emissions and those in countries with lower GHG emissions per capita. In our analysis, we use Equation 1 with PB value as the dependent variable. The results, presented in Table 8, follow a similar framework to the baseline model, where we progressively include control variables and fixed effects from column (1) to column (4). Of particular interest is the coefficient representing the interaction between high per capita GHG emissions and COP21.

Interpreting the results from column (4), we find that the reduction in PB value is more significant for firms located in countries with high per capita GHG emissions per capita than those with lower emissions per capita. Specifically, the reduction in PB value for firms in high GHG emissions per capita countries is economically estimated to be 0.337 units (12.6 percent of average PB value) higher than for firms in low GHG emissions per capita countries. These findings provide support for hypothesis 2a.

4.6. Impact on firm profitability

The baseline analysis in Table 5 suggests that Climate agreements, such as COP21, impact manufacturing firms in countries with high GHG emissions per capita. These firms tend to withhold capital investments due to transition risks, such as government regulations or customer backlash. Consequently, as indicated in Table 8, the firms forego growth opportunities, directly impacting their future cash flows and overall valuation.

However, if the reduction in firm valuation can be solely attributed to future cash flows, it should not impact the profitability derived from existing assets. To investigate this, we perform a regression analysis using Equation 1, with firm profitability as the dependent variable. We utilize two proxies for firm profitability: EBITDA and ROA.

The results of this analysis are presented in Table 9, where column (1) to column (4) represent the findings using EBITDA, while columns (5) to column (8) display the results using ROA. Similar to baseline analysis, we progressively include control variables and fixed effects from column (1) to column (4) for EBITDA and column (5) to column (8) for ROA.

Interpreting the results from column (4) and column (8), the profitability results exhibit a positive trend and are marginally significant at a 10 percent level. These findings suggest that following COP21, firms in countries with high GHG emissions per capita demonstrate slightly higher profitability compared to firms in countries with low GHG emissions per capita. These results provide additional evidence supporting the notion that COP21 introduces uncertainty regarding future cash flow for firms in high-emission countries, consequently reducing their firm valuation. However, this does not significantly impact the current profitability from the existing assets of the firms.

5. Robustness tests

5.1. Robustness with Coarsened exact matching

One potential issue in identifying the effects of treatment in a specification arises from pre-treatment differences between the two groups of firms. It is arguable that post-treatment differences can be attributed to pre-treatment disparities between the two groups. To address this concern, previous research recommends the use of pre-treatment matching between the two groups (Blackwell, Iacus, King, & Porro, 2009; Boampong, 2020; Petrov & Ryan, 2021). Pre-treatment matching ensures the absence of any pre-treatment differences between the two groups. As a result, any differences observed after the treatment can be ascribed to the treatment itself. Similar to prior research, we employ Coarsened Exact Matching (CEM) in our analysis (Blackwell et al., 2009; Boampong, 2020; Petrov & Ryan, 2021).

Using the CEM method, we match the key dependent variable, i.e., the capital expenditure intensity of the two groups before the treatment. Subsequently, we run the specification outlined in Equation 1 on the matched dataset. Table 12 presents the results of running Equation 1 on the matched sample. Similar to the baseline results, we progressively include additional controls and fixed effects from Column (1) to Column (4). Notably, the interaction of high GHG emissions per capita and the COP21 indicator is consistently negative and significant. This implies that the reduction in capital expenditure intensity of firms in countries with high GHG emissions per capita is higher than that of firms in countries with low GHG emissions per capita. These results further support the validity of our findings.

5.2. Robustness with alternate specification

Another potential issue with identification arises from the assignment of firms into two groups. It can be argued that post-treatment differences between the two groups could be attributed to the assignment based on the median. To address this concern, we attempt to mitigate it by using alternate specifications and utilizing the exact values (continuous variable) of GHG emissions per capita for countries. Consequently, we run the specification outlined in Equation 1 with the exact GHG emissions per capita values. The results of this analysis are presented in Column (1) to Column (4) of Table 11. The findings reveal a declining trend in capital expenditure intensity with increasing GHG emissions per capita. Notably, after COP21, the reduction becomes more pronounced for firms in countries with high GHG emissions per capita. These results remain consistent with the baseline findings, suggesting that the reduction in capital expenditure intensity is higher for firms in high GHG emissions per capita countries compared to firms in low GHG emissions per capita countries.

Furthermore, one might argue that the results are influenced by the choice of the independent variable, i.e., GHG emissions per capita. To address this concern, we aim to alleviate it by employing an alternative variable, Total GHG emissions, instead of GHG emissions per capita. Consequently, we run the previous specification with Total GHG emissions as the independent variable. The results of this analysis are shown in Column (5) to Column (8) of Table 11. Using Column (8) for interpretation, the findings indicate no discernible general trend in capital expenditure intensity associated with Total GHG emissions. However, the reduction in capital expenditure intensity remains higher for firms in countries with high total GHG emissions. These results are consistent with the baseline hypothesis, providing further robustness to our initial findings.

5.3. Robustness with placebo

Another potential identification concern arises from the possibility that post-treatment differences may be attributed to factors unrelated to the treatment itself. We can address this concern by employing a placebo test. In the placebo test, we create a sample of firms from 2001 to 2010 and administer a placebo or fake treatment in 2005. If non-treatment-related factors drive the post-treatment differences observed in the baseline results, we should expect similar results when a fake treatment or placebo was introduced in 2005. Conversely, if the post-treatment differences are attributed to the treatment, the placebo in 2005 should not exhibit similar post-treatment differences.

To conduct the placebo test, we run equation 1 using the sample of firms from 2001 to 2010, treating the year 2005 (COP2005) as the placebo treatment. The results of this analysis are presented in Table 13. Similar to the baseline, we progressively add controls from Column (1) to Column (4). The coefficient of the interaction between GHG emissions per capita high and COP2005 is of particular interest. Surprisingly, the results are opposite to those of the baseline. They indicate that after 2005, there was an increase in capital expenditure intensity for firms in countries with high GHG emissions per capita compared to firms in countries with low GHG emissions per capita. This finding provides robust support for our baseline results, as it demonstrates that the COP21 treatment inhibits the growth of investment in capital expenditure intensity and reverses the trend. Moreover, it offers evidence of the significance of global agreements on climate change.

In summary, the placebo test helps us validate the impact of the COP21 treatment by introducing a fake treatment in 2005. The results confirm the treatment's effectiveness and shed light on the importance of international agreements in addressing climate change.

5.4. Robustness with firm-level analysis

Another identification concern may arise concerning the country-level variable, i.e., GHG emissions per capita, which explains the micro-agent response, i.e., the firm's capital expenditure intensity. Although we control for country-level time-invariant fixed effects, one could still argue that specific countries' trends influence the results. To address this concern, we conduct a micro-level analysis that utilizes the firm's environmental scores (E-score) to mitigate potential identification issues. The E-score measures a company's impact on living and non-living natural systems, including the air, land, and water, as well as complete ecosystems. It reflects how well a company employs best management practices to avoid environmental risks and capitalize on environmental opportunities to generate long-term shareholder value (Refinitiv, 2021). [3]

In this firm-level analysis, we examine whether there is a differential response to COP21 among firms with low E-scores (high emissions) compared to firms with high E-scores (low emissions). If, post-COP21, firms with low E-scores significantly reduce their capital expenditure intensity compared to firms with high E-scores, then we can be confident that the country-level phenomena also work at the firm level. Moreover, the major advantage of the firm-level analysis is that it enables us to incorporate country-industry-time fixed effects, thus alleviating concerns associated with country-level trends influencing the results.

For the analysis, we merged our initial sample with E-scores from the Asset 4 database, which has been extensively used in past research (Apergis, Poufinas, & Antonopoulos, 2022; Filippou & Taylor, 2021). Not all firms report E-scores, resulting in a significant decrease in the number of observations. After the initial merge, we obtained 6103 firm-year observations (895 unique firms) for our baseline specification. Based on the arguments for the country-level study, we anticipated observing that firms with low E-scores (or lower

[3] https://www.refinitiv.com/content/dam/marketing/en_us/documents/methodology/refinitivesg-scoresmethodology.pdf

environmental performance) would experience a more substantial reduction in capital expenditure intensity compared to firms with high E-scores. The results of the analysis are presented in Panel A of Table 10.

Similar to the country-level analysis, we incrementally added controls and fixed effects to the model from Column (1) to Column (3) for capital expenditure intensity and from Column (4) to Column (6) for PB Value. Column (1) and Column (4) include time-invariant fixed effects without controls and interactive (time-variant) fixed effects. Column (2) and Column (5) include controls, time-invariant fixed effects, and industry-year interactive (time-variant) fixed effects. Lastly, Column (3) and Column (6) include controls, time-invariant fixed effects, and country-industry-year interactive (time-variant) fixed effects.

The results align closely with the country-level analysis, indicating that the decrease in capital expenditure intensity and valuation after COP21 is more pronounced for firms with low environmental scores (high emissions) compared to firms with high environmental scores (low emissions). However, the reduction in capital expenditure intensity is found to be significant only at the 10% level.

To provide further clarity on the findings, we replicate the analysis for the subsample of firms in countries with high and low GHG emissions per capita. We anticipate that high-emission countries will primarily influence the results due to their more stringent enforcement of climate policies. The results of the subsample analysis for high and low GHG emission countries are presented in Panel B and Panel C of Table 10. As expected, the results are significant for firms operating in countries with high GHG emissions.

Additionally, the raw means trends are presented in Figure 5. In Panel A, we observe that after COP21, firms with low environmental scores decrease their capital expenditure intensity, while firms with high environmental scores increase their capital expenditure intensity. Similarly, post-COP21, firms with low environment scores have reduced valuation compared to firms with high environment scores. The graphs visually confirm the anticipated differential response of firms with high and low environmental scores. Furthermore, Panels B and C demonstrate that the results are primarily driven by firms operating in countries with high GHG emissions.

In conclusion, the advantage of firm-level results lies in utilizing country-industry-year fixed effects. Even after incorporating country-industry-year fixed effects, the alignment of results between the firm-level and country-level analyses suggests that country-level trends do not influence the outcomes. Consequently, firm-level results further validate and strengthen the baseline findings.

6. Conclusion

In this paper, we examine whether firms respond to the commitments made by countries in the Paris Agreement (COP21) by altering their capital investment intensity. We hypothesize that the manufacturing firms located in countries with higher ex-ante emissions reduce their capital investment intensity in the post-COP21 period. Based on a quasi-natural experimental setting, we empirically analyze the impact of the agreement on the investment decisions of firms domiciled in countries with ex-ante high and low GHG emissions.

We find that the capital investment intensity of manufacturing firms in countries with high per capita GHG emissions have reduced significantly compared to those in countries with low per capita GHG emissions in the post-COP21 period. Due to aggressive commitments to curtail the emissions in countries with ex-ante higher emissions, future growth opportunities of manufacturing firms located in those countries are likely to be adversely impacted. As countries declared their Nationally Determined Contributions (NDCs) under the Paris Agreement, governments are expected to implement policy interventions to meet targets announced in NDCs. Furthermore, we also find that the market valuation of manufacturing firms in high per capita emission countries significantly reduced after the Paris Agreement compared to the market valuation of manufacturing firms in low per capita emission countries. Our findings are reinforced with a subsample of firms with high and low environment scores (E-score). We find that investment intensity and valuation have reduced for firms with lower E-scores located in high GHG emission countries in the post-COP21 period. Our study contributes to the literature on the real effects of global agreements such as the Paris Agreement(COP21).

These results highlight that the commitments to reduce GHG emissions have the desired impact at the firm level. Both the firms and the equity markets consider the Paris Agreement to have a material impact in terms of future growth prospects of firms faced with aggressive reductions in GHG emissions. Our study complements the previous literature on the pricing of climate risk in financial markets, leading to a higher cost of capital for firms exposed to climate risk. Additionally, the findings from the study indicate a transfer of investment intensity from the high GHG emissions countries to low GHG emission countries. As the commitments have given a clear roadmap for transition, on the one hand, the firms located in countries with higher GHG emissions are likely to pass up opportunities; on the other hand, firms located in countries with low GHG emissions are likely to increase the investment intensity.

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Table 1: Industry details of the sample

SIC	Industry Name	Freq.	Percent	Cum.
28	Chemicals and Allied Products	12017	17.48	17.48
36	Electronic and Other Electrical Equipment and Components	8,792	12.79	30.27
20	Food and Kindred Products	7276	10.58	40.85
35	Industrial and Commercial Machinery and Computer Equipment	7,271	10.58	51.43
33	Primary Metal Industries	4,794	6.97	58.4
38	Measuring, Photographic, Medical, Optical Goods, Clocks	4445	6.47	64.87
37	Transportation Equipment	3992	5.81	70.68
32	Stone, Clay, Glass, and Concrete Products	3,455	5.03	75.71
34	Fabricated Metal Products	2,835	4.12	79.83
22	Textile Mill Products	2,434	3.54	83.37
26	Paper and Allied Products	2173	3.16	86.53
30	Rubber and Miscellaneous Plastic Products	2,032	2.96	89.49
27	Printing, Publishing and Allied Industries	1708	2.48	91.97
23	Apparel, Finished Products from Fabrics and Similar Materials	1,377	2	93.97
39	Miscellaneous Manufacturing Industries	1,023	1.49	95.46
29	Petroleum Refining and Related Industries	943	1.37	96.83
24	Lumber and Wood Products, Except Furniture	940	1.37	98.2
25	Furniture and Fixtures	643	0.94	99.14
31	Leather and Leather Products	398	0.58	99.72
21	Tobacco Products	193	0.28	100
	Total	68741	100	

Table 2: Distribution of countries in the sample

Country	Freq.	Percent	Cum.	Country	Freq.	Percent	Cum.
China	13546	19.71	19.71	Peru	266	0.39	94.41
United States	8906	12.96	32.66	Philippines	258	0.38	94.78
Japan	8777	12.77	45.43	Romania	241	0.35	95.13
India	6516	9.48	54.91	Nigeria	235	0.34	95.47
Malaysia	2582	3.76	58.67	Oman	232	0.34	95.81
United Kingdom	1855	2.70	61.36	Austria	217	0.32	96.13
Vietnam	1676	2.44	63.80	Ireland	199	0.29	96.42
Thailand	1672	2.43	66.23	Argentina	184	0.27	96.68
France	1490	2.17	68.40	Bangladesh	178	0.26	96.94
Germany	1489	2.17	70.57	Croatia	175	0.25	97.20
Canada	1219	1.77	72.34	Netherlands	172	0.25	97.45
Turkey	1156	1.68	74.02	Tunisia	153	0.22	97.67
Australia	1145	1.67	75.69	Norway	135	0.20	97.87
Sweden	1032	1.50	77.19	Kuwait	125	0.18	98.05
Pakistan	1023	1.49	78.68	Serbia	115	0.17	98.22
Indonesia	986	1.43	80.11	Morocco	110	0.16	98.38
Poland	934	1.36	81.47	Colombia	106	0.15	98.53
Israel	878	1.28	82.75	United Arab Emirates	105	0.15	98.68
Switzerland	744	1.08	83.83	Kenya	90	0.13	98.81
Singapore	727	1.06	84.89	New Zealand	89	0.13	98.94
Italy	680	0.99	85.88	Lithuania	87	0.13	99.07
Brazil	536	0.78	86.66	Portugal	78	0.11	99.18
Sri Lanka	527	0.77	87.42	Luxembourg	77	0.11	99.29
Russian Federation	478	0.70	88.12	Slovenia	71	0.10	99.40
South Africa	460	0.67	88.79	Ukraine	64	0.09	99.49
Finland	438	0.64	89.43	Cyprus	63	0.09	99.58
Saudi Arabia	438	0.64	90.06	Hungary	58	0.08	99.67
Greece	417	0.61	90.67	Qatar	55	0.08	99.75
Bulgaria	372	0.54	91.21	Ghana	51	0.07	99.82
Spain	359	0.52	91.73	Estonia	38	0.06	99.88
Denmark	347	0.50	92.24	Iceland	24	0.03	99.91
Chile	337	0.49	92.73	Bahrain	18	0.03	99.94
Jordan	333	0.48	93.21	Czech Republic	16	0.02	99.96
Mexico	281	0.41	93.62	Kazakhstan	16	0.02	99.98
Belgium	273	0.40	94.02	Lebanon	11	0.02	100.00
Total					68741	100	

Table 3: Variable definition and data sources

VARIABLES	Description	Source
Capital Expenditure Intensity	Capital expenditure as a percentage of total assets (WC04601/Lag.WC02501)	Worldscope
COP21	Dummy variable which takes value 1 for year after COP21 (Year 2015), and 0 otherwise	
COP2005	Dummy variable which takes value 1 for year after 2005, and 0 otherwise. The variable is used in the Placebo analysis.	
GHG per capita	Per Capita Greenhouse Gas (GHG) emissions in Tons CO2 equivalent (tCO2e)	Climate Watch
GHG per capita high	Dummy variable which takes value 1 for countries with GHG per capita higher than the median value in the sample. The variable is calculated based on year 2014 and remain consistent throughout the years	Climate Watch
Total GHG	Total giga tons of Greenhouse Gas (GHG) emission	Climate Watch
E-score	The Environmental Score (E-score) is a comprehensive metric that evaluates companies based on their emissions, innovation, and resource utilization. Emissions are assessed in terms of CO2 emissions, waste management, and biodiversity preservation. The innovation aspect encompasses environmental product innovations and revenues generated from green initiatives. Lastly, resource use evaluates the company's responsible consumption of water, energy, and sustainable packaging practices.	Asset 4
E-score low	Dummy variable which takes value 1 for countries with E-score lower than the median value in the sample. The variable is calculated based on year 2014 and remain consistent throughout the years	Asset4
Cashflow	Operating cash flow as a percentage of total assets of the firm (WC04201/ WC02999)	Worldscope
PB Value	Ratio of price to book value of the equity (WC07210/ WC07220)	Worldscope
EBITDA	EBIDTA to total assets of the firm (WC01250/WC02999)	Worldscope
ROA	Return on assets (WC01706/(0.5(WC02999 + Lag.WC02999))	Worldscope
Z-score	The Altman Z-score is an estimate of the likelihood of a company going bankrupt. It is calculated using the following measures: 1.2 $\times$ Working capital to assets +1.4 $\times$ Retained earnings to total assets +3.3 $\times$ EBITDA to total assets +0.6 $\times$ Market value of equity divided by book value of liabilities +0.999 $\times$ Sales to assets	Worldscope
GDP	Log of GDP (nominal) of a country in US dollars	World Bank
GDP Growth	Annual GDP growth of a country	World Bank
Financial Freedom	The index is "indicator of banking effciency and a measure of independence from government control and interference in the financial sector"(*Index of Economic Freedom*, 2023, p.411). A high value indicates greater financial freedom.	IEF
Investment Freedom	The index calculates the restrictions typically imposed on investments, including limitations on land ownership, sectoral investment restrictions, and capital controls. A high value indicates greater investment freedom.	IEF
OECD	The dummy variable takes a value of 1 for countries in the Organisation for Economic Co-operation and Development (OECD) and 0 otherwise. This variable is used to indicate the quality of institutions.	OECD

Table 4: Descriptive Statistics

Variable	N	Mean	Std. Dev.	Min	Max	p(10)	P(50)	P(90)
Capital Expenditure Intensity	68741	0.230	0.335	0.000	2.548	0.025	0.142	0.463
GHG per capita	68741	9.649	5.714	1.630	26.320	2.440	8.700	19.230
Total GHG	68741	7.154	1.741	3.367	9.435	4.467	7.165	9.381
Cashflow	68741	0.049	0.160	-3.597	0.319	-0.027	0.067	0.153
PB Value	68741	2.677	3.795	0.000	29.128	0.470	1.549	5.520
EBITDA	68741	0.024	0.200	-4.440	0.305	-0.063	0.048	0.142
Z-score	68741	3.879	6.772	-150.282	37.597	0.880	2.760	8.334
GDP	68741	28.509	1.594	24.575	30.653	26.345	28.656	30.455
GDP Growth	68741	4.021	2.775	-1.973	9.551	0.707	3.134	7.766
Financial Freedom	68741	53.383	17.952	20.000	90.000	30.000	50.000	80.000
Investment Freedom	68741	52.909	21.959	15.000	95.000	25.000	60.000	80.000

Notes: P(x) refers to the xth percentile of the distribution. The definition of each of the variables is given in Table 3.

Table 5: Effect of COP21 and GHG emission per capita dummy on CAPEX Intensity

VARIABLES	(1) CAPEX	(2) CAPEX	(3) CAPEX	(4) CAPEX
GHG per capita high × COP21	-0.012**	-0.023***	-0.021***	-0.018***
	(0.005)	(0.005)	(0.005)	(0.006)
Cashflow_{t-1}		0.033	0.034	0.037
		(0.044)	(0.044)	(0.044)
PB Value_{t-1}		0.008***	0.008***	0.008***
		(0.001)	(0.001)	(0.001)
EBITDA_{t-1}		0.092**	0.089**	0.088**
		(0.043)	(0.043)	(0.043)
Z-score_{t-1}		0.005***	0.005***	0.005***
		(0.001)	(0.001)	(0.001)
GDP_{t-1}			-0.102***	-0.100***
			(0.012)	(0.012)
GDP Growth_{t-1}			0.005***	0.005***
			(0.001)	(0.001)
Year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry FE	No	No	No	Yes
Industry-Year FE	No	No	No	Yes
Observations	88,315	68,741	68,741	68,741
Adjusted R-squared	0.308	0.334	0.335	0.335

Notes: CAPEX represents capital intensity within the timeframe spanning from 2012 to 2019. The calculation of *GHG per capita high* entails utilizing the median values of *GHG emissions per capita*. Our primary focus lies in exploring the interaction between *GHG per capita high* and the *COP21*. The precise definitions of the variables used in this study are presented in Table 3. Furthermore, the *Observations* signifies the total number of firm-year observations considered within the estimation sample. Significance levels are represented by asterisks, *** for the 1% level, ** for the 5% level, and * for the 10% level. In addition, we present heteroskedasticity-consistent robust standard errors clustered at the *firm level*, enclosed within parentheses.

Table 6: Heterogeneity analysis of effect of COP21 and GHG emission per capita dummy on CAPEX Intensity: Subsample analysis

	Financial Freedom		Investment Freedom		Institutional Quality	
	Low	High	Low	High	non-OECD	OECD
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	CAPEX	CAPEX	CAPEX	CAPEX	CAPEX	CAPEX
GHG per capita high × COP21	-0.027***	0.002	-0.022***	-0.004	-0.024***	-0.013
	(0.006)	(0.012)	(0.006)	(0.014)	(0.007)	(0.011)
Cashflow_{t-1}	0.001	0.104	0.042	0.030	-0.053	0.094
	(0.044)	(0.069)	(0.049)	(0.086)	(0.058)	(0.058)
PB Value_{t-1}	0.005***	0.011***	0.006***	0.017***	0.005***	0.011***
	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.002)
EBITDA_{t-1}	0.305***	0.010	0.148***	0.007	0.321***	0.020
	(0.051)	(0.061)	(0.049)	(0.081)	(0.060)	(0.054)
Z-score_{t-1}	0.008***	0.004***	0.005***	0.006***	0.006***	0.005***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
GDP_{t-1}	-0.121***	-0.051	-0.101***	-0.028	-0.081***	-0.040**
	(0.012)	(0.032)	(0.014)	(0.023)	(0.019)	(0.019)
GDP Growth_{t-1}	0.004***	0.004*	0.004***	0.004*	0.001	0.003**
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	43,818	24,919	55,783	12,953	34,722	34,017
Adjusted R-squared	0.271	0.365	0.317	0.374	0.250	0.388

Notes: CAPEX represents capital intensity within the timeframe spanning from 2012 to 2019. The calculation of *GHG per capita high* entails utilizing the median values of *GHG emissions per capita*. Our primary focus lies in exploring the interaction between *GHG per capita high* and the *COP21*. The precise definitions of the variables used in this study are presented in Table 3. Furthermore, the *Observations* signifies the total number of firm-year observations considered within the estimation sample. Significance levels are represented by asterisks, *** for the 1% level, ** for the 5% level, and * for the 10% level. In addition, we present heteroskedasticity-consistent robust standard errors clustered at the *firm level*, enclosed within parentheses.

Table 7: Effect of COP21 and GHG emission per capita dummy on CAPEX Intensity

VARIABLES	(1) CAPEX	(2) CAPEX	(3) CAPEX	(4) CAPEX
GHG per capita high × Year 2016	-0.018**	-0.035***	-0.030***	-0.026***
	(0.007)	(0.008)	(0.008)	(0.008)
GHG per capita high × Year 2017	-0.005	-0.017**	-0.014*	-0.013*
	(0.007)	(0.007)	(0.007)	(0.008)
GHG per capita high × Year 2018	-0.009	-0.017**	-0.020**	-0.017**
	(0.007)	(0.008)	(0.008)	(0.008)
GHG per capita high × Year 2019	-0.017**	-0.020***	-0.019**	-0.015*
	(0.007)	(0.008)	(0.008)	(0.008)
Cashflow_{t-1}		0.033	0.034	0.037
		(0.044)	(0.044)	(0.044)
PB Value_{t-1}		0.008***	0.008***	0.008***
		(0.001)	(0.001)	(0.001)
EBITDA_{t-1}		0.092**	0.089**	0.088**
		(0.043)	(0.043)	(0.043)
Z-score_{t-1}		0.005***	0.005***	0.005***
		(0.001)	(0.001)	(0.001)
GDP_{t-1}			-0.101***	-0.099***
			(0.012)	(0.013)
GDP Growth_{t-1}			0.005***	0.005***
			(0.001)	(0.001)
Year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry FE	No	No	No	Yes
Industry-Year FE	No	No	No	Yes
Observations	88,315	68,741	68,741	68,741
Adjusted R-squared	0.308	0.334	0.335	0.335

Notes: CAPEX represents capital intensity within the timeframe spanning from 2012 to 2019. The calculation of *GHG per capita high* entails utilizing the median values of *GHG emissions per capita*. Our primary focus lies in exploring the interaction between *GHG per capita high* and the *Year* dummies. The interaction shows the incremental year-on-year marginal impact of COP21 on capital intensity. The precise definitions of the variables used in this study are presented in Table 3. Furthermore, the *Observations* signifies the total number of firm-year observations considered within the estimation sample. Significance levels are represented by asterisks, *** for the 1% level, ** for the 5% level, and * for the 10% level. In addition, we present heteroskedasticity-consistent robust standard errors clustered at the *firm level*, enclosed within parentheses.

Table 8: Effect of COP21 and GHG emission per capita dummy on PB Value

VARIABLES	(1) PB Value	(2) PB Value	(3) PB Value	(4) PB Value
GHG per capita high $\times$ COP21	-0.284***	-0.301***	-0.300***	-0.337***
	(0.052)	(0.053)	(0.054)	(0.057)
Cashflow_{t-1}		0.878	0.877	0.873
		(0.597)	(0.597)	(0.596)
EBITDA_{t-1}		0.326	0.327	0.343
		(0.502)	(0.502)	(0.497)
Z-score_{t-1}		0.026***	0.026***	0.025***
		(0.006)	(0.006)	(0.006)
GDP_{t-1}			0.035	0.063
			(0.106)	(0.107)
GDP Growth_{t-1}			0.001	-0.004
			(0.010)	(0.010)
Year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry FE	No	No	No	Yes
Industry-Year FE	No	No	No	Yes
Observations	88,642	69,309	69,309	69,309
Adjusted R-squared	0.443	0.507	0.507	0.508

Notes: PB Value represents price to book ratio within the timeframe spanning from 2012 to 2019. The calculation of *GHG per capita high* entails utilizing the median values of *GHG emissions per capita*. Our primary focus lies in exploring the interaction between *GHG per capita high* and the *COP21*. The precise definitions of the variables used in this study are presented in Table 3. Furthermore, the *Observations* signifies the total number of firm-year observations considered within the estimation sample. Significance levels are represented by asterisks, *** for the 1% level, ** for the 5% level, and * for the 10% level. In addition, we present heteroskedasticity-consistent robust standard errors clustered at the *firm level*, enclosed within parentheses.

Table 9: Effect of COP21 and GHG emission per capita dummy on firm profitability

	EBITDA				ROA			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	EBITDA	EBITDA	EBITDA	EBITDA	ROA	ROA	ROA	ROA
GHG per capita high × COP21	0.004	0.003	0.003	0.005*	0.002	0.002	0.002	0.003*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Cashflow_{t-1}		0.258***	0.258***	0.258***		0.315***	0.315***	0.315***
		(0.042)	(0.042)	(0.042)		(0.032)	(0.032)	(0.032)
PB Value_{t-1}		0.001	0.001	0.001		0.001	0.001	0.001
		(0.001)	(0.001)	(0.001)		(0.001)	(0.001)	(0.001)
Z-score_{t-1}		0.001	0.001	0.001		0.001***	0.001***	0.001***
		(0.001)	(0.001)	(0.001)		(0.000)	(0.000)	(0.000)
GDP_{t-1}			-0.028***	-0.028***			-0.031***	-0.031***
			(0.005)	(0.006)			(0.004)	(0.004)
GDP Growth_{t-1}			0.000	0.000			0.001**	0.001**
			(0.000)	(0.000)			(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	Yes	No	No	No	Yes
Industry-Year FE	No	No	No	Yes	No	No	No	Yes
Observations	96,541	70,529	70,529	70,529	80,993	70,528	70,528	70,528
Adjusted R-squared	0.658	0.667	0.667	0.667	0.705	0.739	0.739	0.739

Notes: EBITDA represents Earnings Before Interest, Taxes, Depreciation, and Amortization within the timeframe spanning from 2012 to 2019. ROA represents return on assets within the timeframe spanning from 2012 to 2019. The calculation of *GHG* entails utilizing the median values of *GHG emissions per capita*. Our primary focus lies in exploring the interaction between *GHG per capita high* and the *COP21*. The precise definitions of the variables used in this study are presented in Table 3. Furthermore, the *Observations* signifies the total number of firm-year observations considered within the estimation sample. Significance levels are represented by asterisks, *** for the 1% level, ** for the 5% level, and * for the 10% level. In addition, we present heteroskedasticity-consistent robust standard errors clustered at the *firm level*, enclosed within parentheses.

Table 10: Effect of COP21 and Environmental scores dummy on firm capital expenditure intensity and PB Value

Panel A **Full sample**	(1) CAPEX	(2) CAPEX	(3) CAPEX	(4) PB Value	(5) PB Value	(6) PB Value
E-score low × COP21	-0.019***	-0.013**	-0.013*	-0.592***	-0.654***	-0.937***
	(0.006)	(0.006)	(0.007)	(0.164)	(0.165)	(0.230)
Controls	No	Yes	Yes	No	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry -Year FE	No	Yes	Yes	No	Yes	Yes
Country-Industry-Year FE	No	No	Yes	No	No	Yes
Observations	8,521	7,029	6,103	8,199	6,954	6,038
Adjusted R-squared	0.485	0.570	0.585	0.679	0.722	0.691
Panel B **High emission countries**	(1) CAPEX	(2) CAPEX	(3) CAPEX	(4) PB Value	(5) PB Value	(6) PB Value
E-score low × COP21	-0.018***	-0.016**	-0.014*	-0.608***	-0.715***	-1.036***
	(0.007)	(0.006)	(0.007)	(0.214)	(0.205)	(0.257)
Controls	No	Yes	Yes	No	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry -Year FE	No	Yes	Yes	No	Yes	Yes
Country-Industry-Year FE	No	No	Yes	No	No	Yes
Observations	5,868	4,746	4,307	5,501	4,657	4,221
Adjusted R-squared	0.511	0.591	0.593	0.632	0.687	0.649
Panel C **Low emission countries**	(1) CAPEX	(2) CAPEX	(3) CAPEX	(4) PB Value	(5) PB Value	(6) PB Value
E-score low × COP21	-0.015	-0.004	-0.005	-0.434*	-0.510*	-0.584
	(0.012)	(0.012)	(0.020)	(0.262)	(0.280)	(0.495)
Controls	No	Yes	Yes	No	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry -Year FE	No	Yes	Yes	No	Yes	Yes
Country-Industry-Year FE	No	No	Yes	No	No	Yes
Observations	2,652	2,274	1,796	2,696	2,287	1,817
Adjusted R-squared	0.442	0.538	0.560	0.785	0.820	0.802

Notes: CAPEX and PB Value represent capital expenditure intensity and price-to-book ratio, respectively, within the timeframe spanning from 2012 to 2019. The calculation of *E-score low* entails utilizing the median values of *Environmental scores*. Our primary focus lies in exploring the interaction between *E-score low* and the *COP21*. The precise definitions of the variables used in this study are presented in Table 3. Furthermore, the *Observations* signifies the total number of firm-year observations considered within the estimation sample. Significance levels are represented by asterisks, *** for the 1% level, ** for the 5% level, and * for the 10% level. In addition, we present heteroskedasticity-consistent robust standard errors clustered at the *firm level*, enclosed within parentheses.

Table 11: Robustness Test: Effect of COP21 and GHG emission per capita and Total GHG emission on CAPEX Intensity

	Using GHG per capita emissions				Using Total GHG emissions			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	CAPEX	CAPEX	CAPEX	CAPEX	CAPEX	CAPEX	CAPEX	CAPEX
GHG per capita	-0.038***	-0.017***	-0.004	-0.005				
	(0.003)	(0.004)	(0.004)	(0.004)				
GHG per capita × COP21	-0.002***	-0.002***	-0.002***	-0.001**				
	(0.001)	(0.001)	(0.001)	(0.001)				
Total GHG					-0.203***	-0.082***	0.000	-0.010
					(0.021)	(0.026)	(0.032)	(0.032)
Total GHG × COP21					-0.016***	-0.013***	-0.008***	-0.008***
					(0.002)	(0.002)	(0.002)	(0.002)
Cashflow_{t-1}		0.034	0.034	0.037		0.035	0.035	0.037
		(0.044)	(0.044)	(0.044)		(0.044)	(0.044)	(0.044)
PB Value_{t-1}		0.008***	0.008***	0.008***		0.008***	0.008***	0.008***
		(0.001)	(0.001)	(0.001)		(0.001)	(0.001)	(0.001)
EBITDA_{t-1}		0.091**	0.089**	0.087**		0.091**	0.089**	0.088**
		(0.043)	(0.043)	(0.043)		(0.043)	(0.043)	(0.043)
Z-score_{t-1}		0.005***	0.005***	0.005***		0.005***	0.005***	0.005***
		(0.001)	(0.001)	(0.001)		(0.001)	(0.001)	(0.001)
GDP_{t-1}			-0.102***	-0.097***			-0.075***	-0.073***
			(0.014)	(0.014)			(0.015)	(0.015)
GDP Growth_{t-1}			0.005***	0.005***			0.004***	0.004***
			(0.001)	(0.001)			(0.001)	(0.001)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	No	No	Yes	No	No	No	Yes
Industry-Year FE	No	No	No	Yes	No	No	No	Yes
Observations	88,315	68,741	68,741	68,741	88,315	68,741	68,741	68,741
Adjusted R-squared	0.309	0.334	0.335	0.335	0.310	0.335	0.335	0.335

Notes: CAPEX represents capital intensity within the timeframe spanning from 2012 to 2019. Our primary focus lies in exploring the interaction between *GHG emissions (GHG per capita and Total GHG emissions)* and the *COP21*. The precise definitions of the variables used in this study are presented in Table 3. Furthermore, the *Observations* signifies the total number of firm-year observations considered within the estimation sample. Significance levels are represented by asterisks, *** for the 1% level, ** for the 5% level, and * for the 10% level. In addition, we present heteroskedasticity-consistent robust standard errors clustered at the *firm level*, enclosed within parentheses.

Table 12: Robustness Test: Effect of COP21 and GHG emission per capita dummy on CAPEX Intensity for matched sample

VARIABLES	(1) CAPEX	(2) CAPEX	(3) CAPEX	(4) CAPEX
GHG per capita high × COP21	-0.007	-0.020***	-0.019***	-0.017***
	(0.006)	(0.006)	(0.006)	(0.006)
Cashflow_{t-1}		0.044	0.045	0.047
		(0.044)	(0.044)	(0.044)
PB Value_{t-1}		0.007***	0.007***	0.007***
		(0.001)	(0.001)	(0.001)
EBITDA_{t-1}		0.184***	0.181***	0.180***
		(0.050)	(0.050)	(0.050)
Z-score_{t-1}		0.005***	0.005***	0.005***
		(0.001)	(0.001)	(0.001)
GDP_{t-1}			-0.078***	-0.075***
			(0.015)	(0.015)
GDP Growth_{t-1}			0.003***	0.003***
			(0.001)	(0.001)
Year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry FE	No	No	No	Yes
Industry-Year FE	No	No	No	Yes
Observations	55,476	43,563	43,563	43,563
Adjusted R-squared	0.309	0.341	0.342	0.342

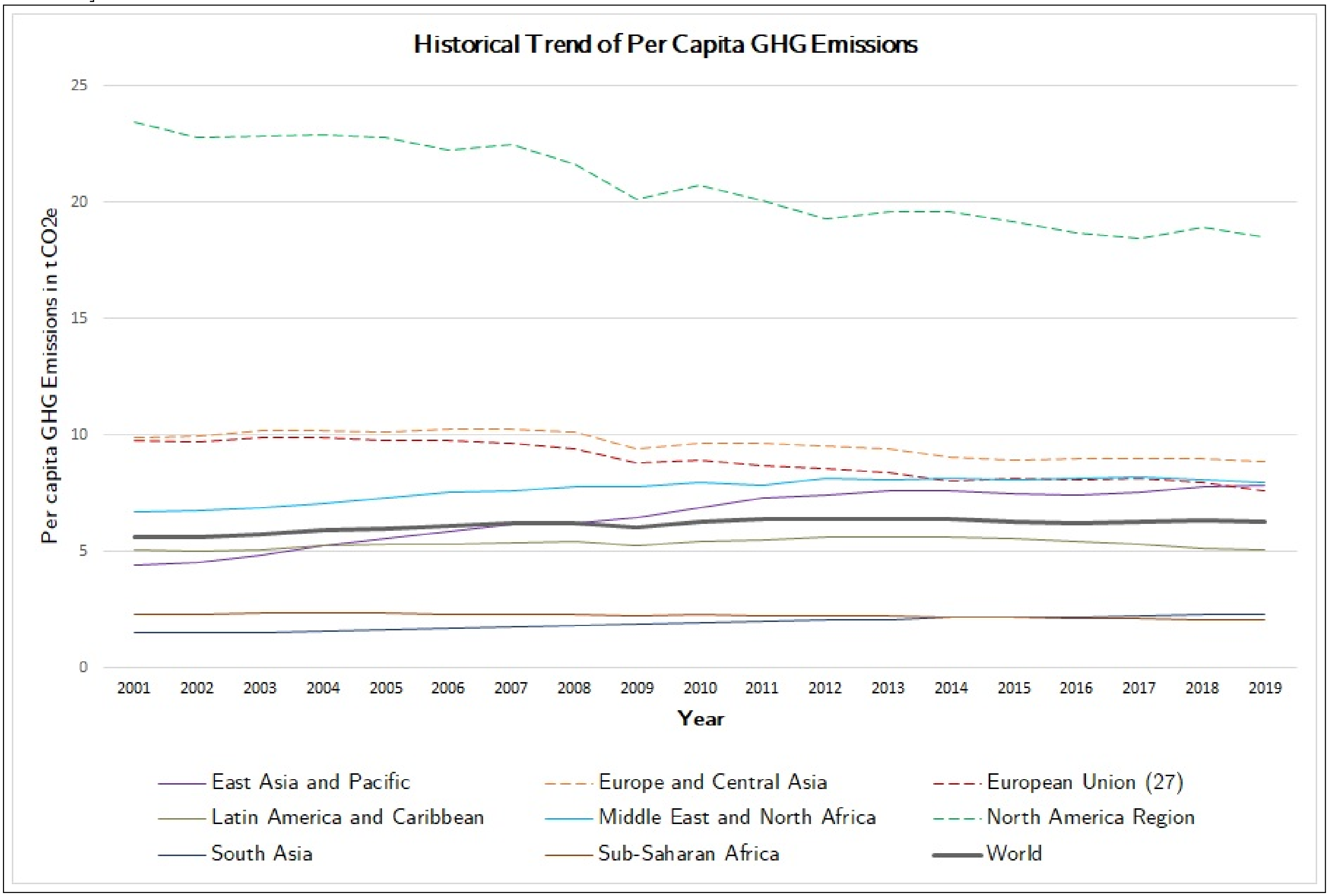
Notes: CAPEX represents capital intensity within the timeframe spanning from 2012 to 2019. The calculation of *GHG per capita high* entails utilizing the median values of *GHG emissions per capita*. Our primary focus lies in exploring the interaction between *GHG per capita high* and the *COP21*. The precise definitions of the variables used in this study are presented in Table 3. Furthermore, the *Observations* signifies the total number of firm-year observations considered within the estimation sample. Significance levels are represented by asterisks, *** for the 1% level, ** for the 5% level, and * for the 10% level. In addition, we present heteroskedasticity-consistent robust standard errors clustered at the *firm level*, enclosed within parentheses.

Table 13: Placebo Test: Effect of COP2005 and CO2 emission per capita dummy on CAPEX Intensity

VARIABLES	(1) CAPEX	(2) CAPEX	(3) CAPEX	(4) CAPEX
GHG per capita high × COP2005	0.019***	0.025***	0.017***	0.015**
	(0.005)	(0.005)	(0.007)	(0.007)
Cashflow_{t-1}		0.199***	0.198***	0.198***
		(0.051)	(0.051)	(0.050)
PB Value_{t-1}		0.012***	0.012***	0.012***
		(0.001)	(0.001)	(0.001)
EBITDA_{t-1}		0.048	0.048	0.045
		(0.049)	(0.049)	(0.049)
Z-score_{t-1}		0.008***	0.008***	0.008***
		(0.002)	(0.002)	(0.002)
GDP_{t-1}			-0.028***	-0.030***
			(0.011)	(0.011)
GDP Growth_{t-1}			0.002**	0.002**
			(0.001)	(0.001)
Year FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry FE	No	No	No	Yes
Industry-Year FE	No	No	No	Yes
Observations	77,388	58,896	58,896	58,896
Adjusted R-squared	0.326	0.351	0.352	0.352

Notes: CAPEX represents capital intensity within the timeframe spanning from 2002 to 2009. The calculation of *GHG per capita high* entails utilizing the median values of *GHG emissions per capita*. Our primary focus lies in exploring the interaction between *CO2 per capita high* and the *COP2005*. The variable *COP2005* represents the fake treatment or placebo in the year 2005. The precise definitions of the variables used in this study are presented in Table 3. Furthermore, the *Observations* signifies the total number of firm-year observations considered within the estimation sample. Significance levels are represented by asterisks, *** for the 1% level, ** for the 5% level, and * for the 10% level. In addition, we present heteroskedasticity-consistent robust standard errors clustered at the *firm level*, enclosed within parentheses.

Figure 1: Historical Trend of Region Wise per Capita GHG Emissions [Source: Climate Watch]

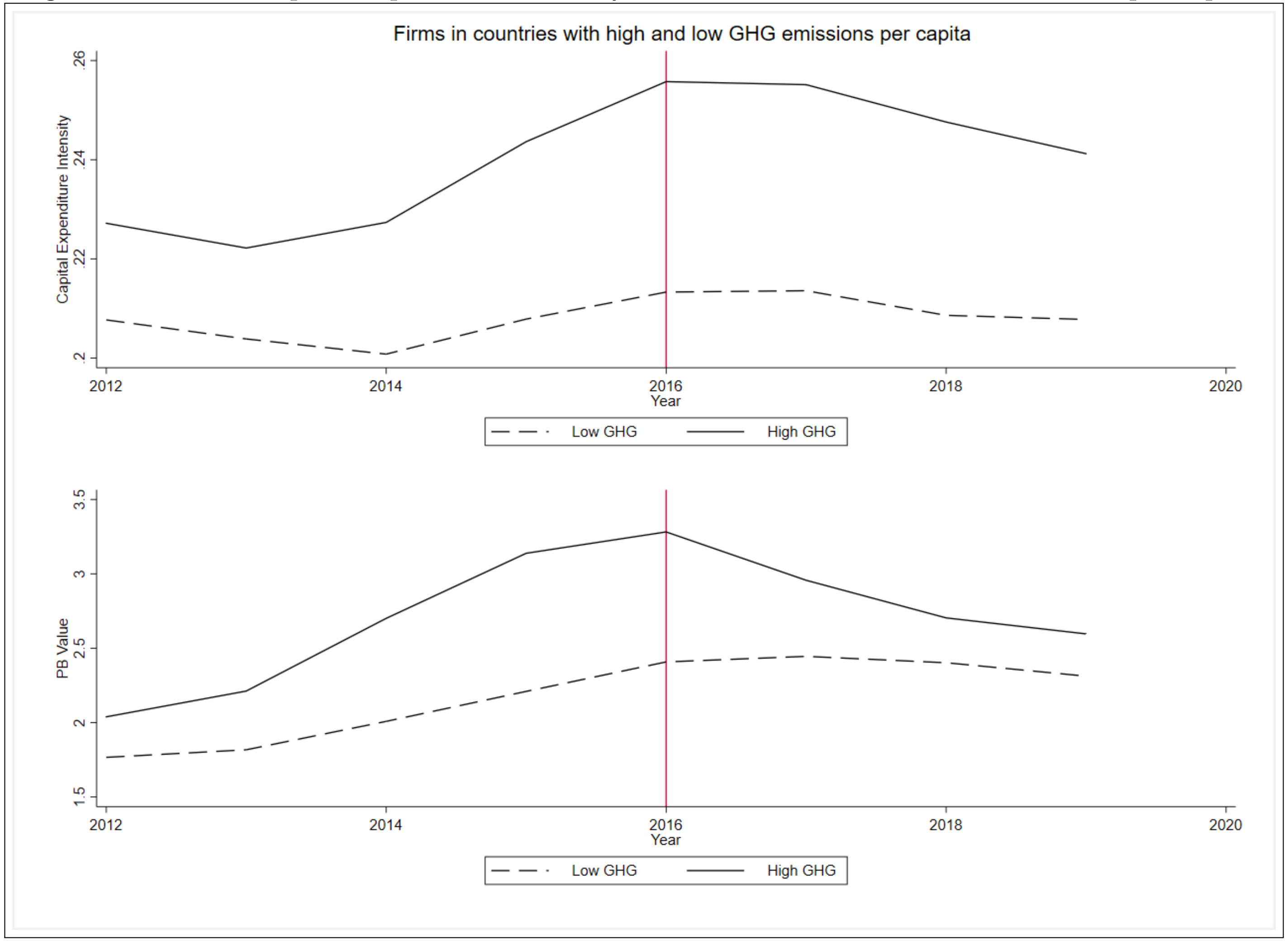


Notes: The figure shows the historical trend of per capita GHG emissions for the world and all the regions of the world in tonne CO_2 equivalent (tCO2e). The unit tCO2e reflects the emission content of all the Green House Gases in CO_2 equivalent terms. The bold black line shows the trend of per capita GHG emissions for the world. The dotted colored lines show the per capita GHG emissions trend for regions with decreasing GHG per capita emissions trends between 2001 and 2019. The solid colored lines show the per capita GHG emissions trend for regions with increasing or static GHG per capita emissions trends between 2001 and 2019.

Figure 2: Distribution of countries in GHG high and GHG low per capita

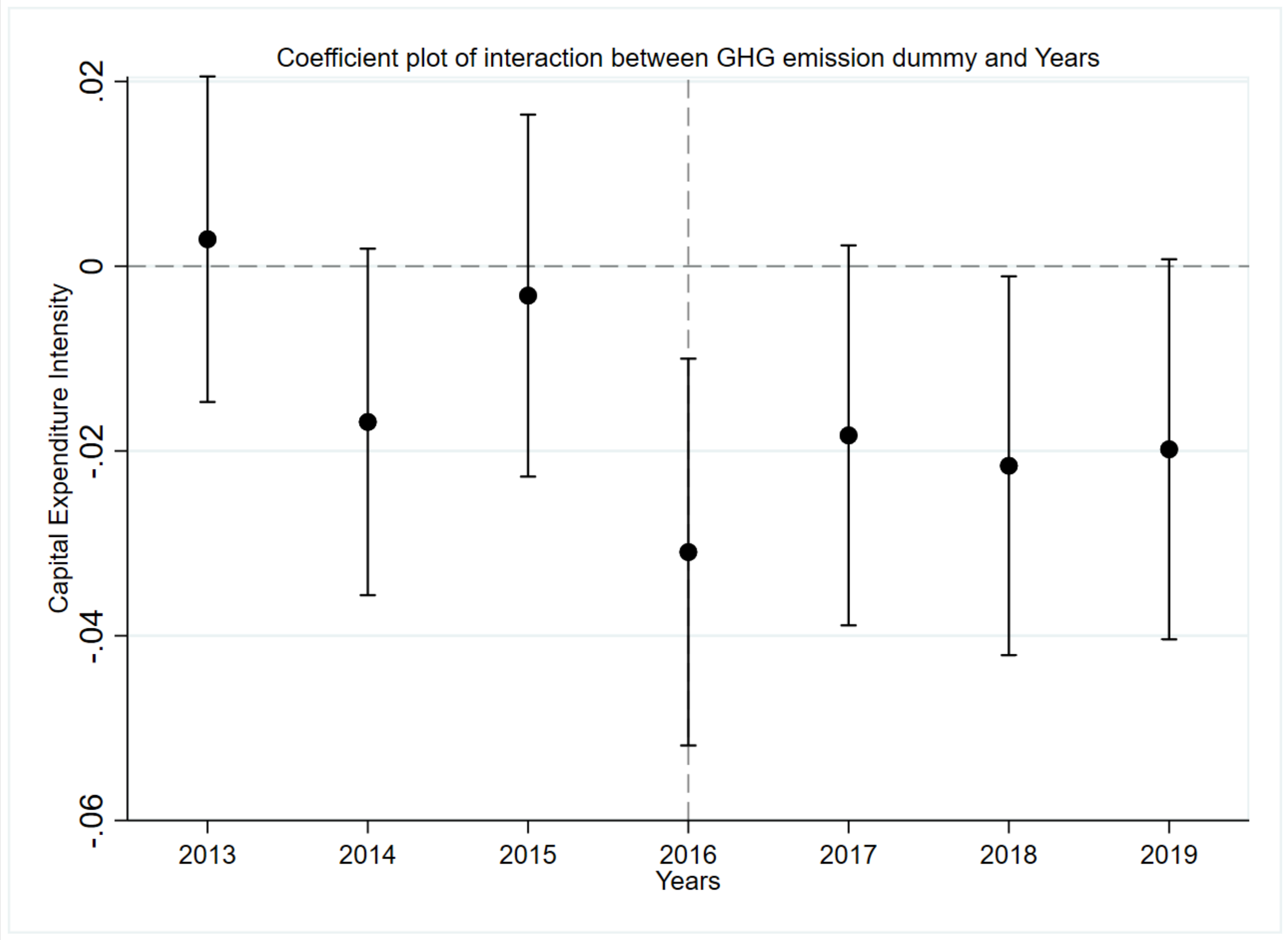
Notes: The figure highlights the distribution of countries based on their median values of GHG emissions per capita in the sample. The top half highlights countries with high GHG emissions per capita, while the bottom half highlights countries with low GHG emissions per capita.

Figure 3: Trend of Capital Expenditure Intensity and PB value based on GHG emissions per capita



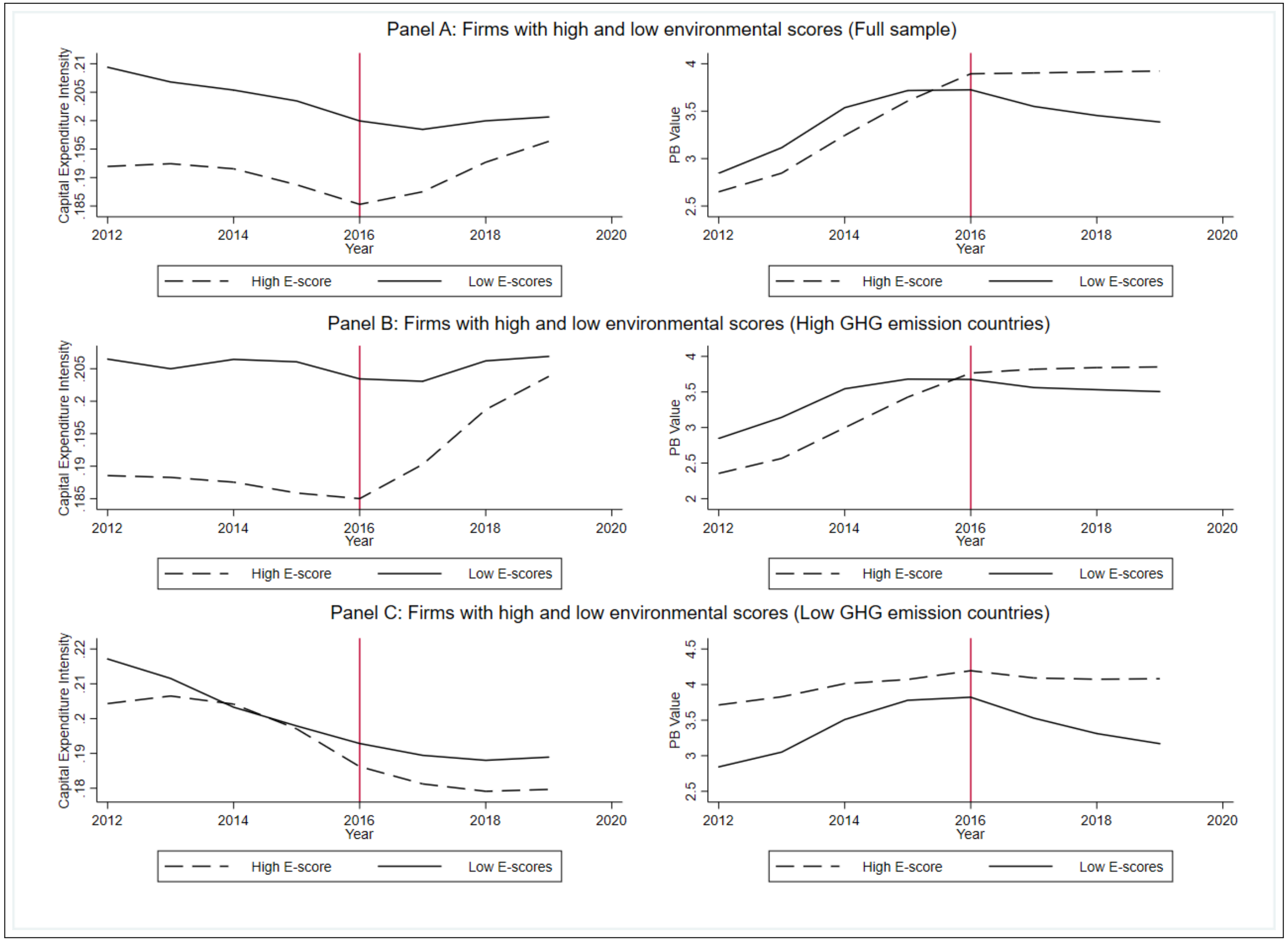
Notes: The figure illustrates the raw mean trends of capital expenditure intensity and PB value for firms in countries with high GHG emissions per capita and firms in countries with low GHG emissions per capita. Firms in high GHG emission countries are represented by a solid line, while those in low GHG emission countries are represented by a dashed line. The trends indicate that after COP21, firms in high GHG emission countries undergo a greater reduction in capital expenditure intensity and PB value compared to firms in low GHG emission countries.

Figure 4: Coefficient Plot



The figure illustrates coefficient plots displaying the interaction between GHG emissions per capita and Year dummies, showing year-on-year differences in capital expenditure intensity for firms in high GHG emissions per capita countries (treatment group) and low GHG emissions per capita countries (control group) relative to the reference year 2012. The plot incorporates controls and fixed effects from baseline regressions. Before COP21, the capital expenditure intensity difference between high and low GHG emissions per capita firms was insignificant, supporting the parallel trend assumption. However, after COP21, the plot indicates a significant negative difference, particularly in 2016 and 2018. This suggests that post-COP21, firms in high GHG emissions per capita countries reduced their capital expenditure intensity more than firms in low GHG emissions per capita countries, relative to the year 2012. The plot primarily justifies the parallel trend assumption by highlighting insignificant pre-treatment (pre-COP21) differences.

Figure 5: Trend of Capital Expenditure Intensity and PB value based on GHG emissions per capita and Environmental scores: Within E-score sample



Notes: The figure illustrates the raw mean trends of capital expenditure intensity and PB value for firms with high and low Environmental scores (E-score). Firms with high E-scores are represented by a dashed line, while those with low E-scores are represented by a solid line. Panels A, B, and C show the raw mean trends for all countries (full sample), high GHG emission per capita countries (sub-sample), and low GHG emission per capita countries (sub-sample), respectively. The trends in Panel A suggest that after COP21, firms with low E-scores reduce their capital expenditure intensity and PB value, while firms with high E-scores increase their capital expenditure intensity and PB value. The raw mean trends in the subsample (Panel A and Panel B) indicate that the results are mainly driven by firms in countries with high GHG emissions per capita.