The Green Transition: Evidence from Corporate Green Revenues*

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Abstract

Using a novel measure of a firm's green revenues, this paper sizes up the green economy. We shed light on the factors driving global public companies' expansion of business activities in support of the green transition towards a low-carbon and more environmentally sustainable economy. Our analysis shows that the green economy grew at an accelerated pace after the Paris Agreement. Both regulatory initiatives and innovative US firms converting green patents into actual revenues from green products and services have led to this accelerated growth. We also document that a stronger presence of institutional investors prior to the Paris Agreement is associated with higher green revenues afterwards. Finally, we examine the stock returns of firms with high green revenues and find only modest evidence of a green alpha which seems to be concentrated in US stocks in the post-Paris period.

Keywords: green revenues, sustainability, climate change, climate finance, green impact, ESG

JEL Classifications: G15, G18, G23, G30, Q55

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1 Introduction

The detrimental effects of climate change and environmental degradation pose a major global challenge. Consequently, investors and regulators have begun urging firms to transition to ”green” business models that are low-carbon, more resource-efficient, and generally more environmentally sustainable. The unexpected success of the 2015 Paris Agreement elevated the salience and significance of environmental issues among many different economic agents (e.g., consumers, firms, investors, regulators). However, there has been insufficient progress in the green transition to achieve the goals outlined in the agreement and, more broadly, significant challenges persist in enforcing policies that internalize the social costs of wider environmental externalities (Tirole, 2008). To accelerate the ”greening” of their economies, several regional jurisdictions have introduced green classification systems to define what is environmentally ”sustainable.” The most prominent of these is the EU Taxonomy on Sustainable Finance (EUTSF), which addresses both climate change and other environmental goals such as biodiversity, environmental resource management, and pollution prevention.[1]

In this paper, we aim to fill an important gap in the literature by examining the extent to which publicly-listed firms around the world offer green technological solutions that facilitate the transition to greener economic activities. This is measured by their share of revenues from the sales of environmentally-friendly products and services, i.e. their “green revenues”. We start by examining the evolution of aggregate corporate green revenues and also split these into more granular green business activities. Next, we provide a breakdown by industrial sectors and show important cross-country heterogeneity in green revenues. Second, we investigate whether and how the increased global emphasis on environmental issues spurred by the Paris Agreement impacted the extent to which firms generate green revenues. In doing so, we study the role of public policies as captured, for instance, by the regulatory push (particularly in Europe) towards more environmental sustainability. Third, we shed light on the technological and market drivers of the green transition. Lastly, we analyze the financial consequences for firms transitioning to green business

[1] Regulation (EU) 2020/852 - see https://ec.europa.eu/sustainable-finance-taxonomy/

models as it remains unclear whether these represent profitable investment opportunities or if they might come at a cost to shareholders.

To address these questions, we analyze novel data that captures the extent to which firms sell products and services that contribute positively to the environment. More specifically, we use data from the FTSE Russell Green Revenues Classification System (GRCS), which, to the best of our knowledge, is one of the first, if not the first, to provide comprehensive information on the extent to which firms generate revenues from green products, services, and economic activities. The GRCS evaluates their impact on climate change mitigation and adaptation, water, resource use, pollution, and agricultural efficiency. The data covers over 16,000 publicly-listed firms from 48 developed and emerging markets between 2008 and 2022, spanning a wide range of industries. The GRCS classification precedes but is similar in structure to the more recently introduced EUTSF.

The majority of firms with green revenues sell both green and non-green products. For instance, Toyota generated about 30% of its revenues from green sources in 2022, primarily from its line of hybrid vehicles. However, according to the FTSE Russell estimates, some "pure play" firms like Tesla receive all (100%) their revenues from green sources in the same year. Specifically, sales of electric vehicles (EVs) accounted for 93% of total revenues and the remaining 7% came from solar panels and power storage solutions. The example of Tesla helps to illustrate how the green revenues data differs from ESG ratings where there has been a lot of divergence on whether to measure the sustainability of a firm by looking at the sustainability footprint of its operations (or conduct) versus its products.[2] We show that the low association between ESG ratings and green revenues is more general and goes beyond Tesla. The green revenues measure used in our study provides new information and has a weak correlation with either environmental scores issued by ESG

[2] Wall Street Journal, "Is Tesla or Exxon More Sustainable? It Depends Whom You Ask" (Sept. 17, 2018)."*Perhaps the biggest surprise is Tesla, ranked by MSCI at the top of the industry, and by FTSE as the worst carmaker globally on ESG issues. Sustainalytics puts it in the middle. (...) MSCI gives Tesla a near-perfect score for environment, because it has selected two themes as the most important for the car industry: the carbon produced by its products, and the opportunities the company has in clean technology. FTSE gives Tesla a "zero" on environment, because its scores ignore emissions from its cars, rating only emissions from its factories (...).*"

rating providers or also firm-level Scope 1 and 2 carbon emissions that have been more prominently studied in the academic literature to date (Bolton and Kacperczyk, 2021; Pastor et al., 2022).[3]

The first part of our paper consists of sizing up the "green transition". While the majority of public companies around the world still remain primarily engaged in non-green business activities, we document an acceleration of the shift to green in the period after the Paris Agreement went into effect in 2016. The global percentage of green revenues was essentially flat at about 4% from 2008 until 2015 but then grew to 6.5% by 2022 (the end of our sample period). While this green revenue share calculated as green to total revenues may seem modest, it comprised approximately 3,000 global companies that generated green revenues (a fifth of all firms in the sample). Translating the green revenue share to dollar revenues, we find that aggregate corporate green revenues in 2022 totaled approximately USD $4 trillion. This positions the green economy at about the same size as the oil and gas sector, to which it is often compared.[4] Green economic activities are diversified across several industries with manufacturing being the largest, followed by utilities, but also comprises technology firms. Green revenues are generated all over the world: While the US, China, and Japan have the largest dollar aggregate green revenues, the highest green revenue exposure is observed in Europe where the green share exceeded 10% of total company revenues in countries like France. This suggests that European companies are becoming more aligned with their countries' net-zero goals and broader sustainability goals.

In the second part of the paper we examine possible channels that facilitate the generation of green revenues at the corporate level. For this purpose, we follow Seltzer et al. (2022), amongst other, and use the passage of the Paris Agreement as a shock to the global commitment to combat climate change and address environmental degradation more generally. Engle et al. (2020) lend credence to this choice showing that their climate

[3] ESG ratings (Pastor et al., 2022) have received criticism from both academics (Berg et al., 2022b) and policymakers (`https://bit.ly/49J9bfU`). The focus on carbon emissions has often been on Scope 1 and 2 emissions stemming from firms' business operations (Bolton and Kacperczyk, 2021, 2023; Aswani et al., 2024), which usually do not capture the firms' environmental impact of their products and services.

[4] IBISWorld, "Global Oil and Gas Exploration - Production Market Size 2005–2028".

change news index spikes around the Paris Agreement. Following the literature, the Paris Agreement not only made climate change, and more generally environmental issues, much more salient among many different economic actors (e.g., firms, regulators, investors, or consumers), but it also raised expectations that more stringent environmental regulations would be imposed. For instance, article 2(c) of the Agreement called for "*...making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development*".

In the first channel, we explore how public policy, in particular the roll-out of the post-Paris "European Green Deal", impacts the green revenue share of European companies (relative to firms domiciled in other parts of the world).[5] This regulatory push started with the creation of the High-Level Expert Group on Sustainable Finance in 2016 and the publication of its report in 2018.[6] We also examine the effects following the launch of its cornerstone sustainable finance regulation, the EUTSF, in 2020.[7] Using a difference-in-differences research design and depending on whether we focus on the period following the Paris Agreement, the 2018 publication of the Expert Group report, or the 2020 EUTSF regulation, we estimate treatment effects indicating an increase in European firms' green revenue shares of 1.2 to 1.4 more percentage points compared to non-European firms. These differential effects for European firms are economically significant and amount to about 10 percent of a standard deviation of the green revenue share, highlighting the important impact of regulatory efforts in promoting green revenues in the post-Paris Agreement era. The results are robust to using more strict definitions of green revenues according to the EUTSF classification or the different GRCS tiers of greenness excluding activities with controversial environmental contributions (such as nuclear energy) and focusing only on those with clear and significant environmental benefits.

The green transition requires companies to overcome technological limitations. Therefore, in our second channel we examine the role of corporate innovation, in the form of green patents, to successfully take to market and start generating actual green revenues,

[5] https://bit.ly/4aagjBE
[6] https://bit.ly/3wRpTLC
[7] https://bit.ly/48MjdeR

particularly in the period after the Paris Agreement. We estimate that compared to firms that did not have a green patent prior to the Paris Agreement, firms with at least one green patent pre-Paris experienced an average increase of 2.8 percentage points in green revenue shares after the agreement came into effect. The effect is economically meaningful and represents about twenty percent of a standard deviation. Exploring regional variation, we find, however, that the conversion of green patents into environmental solutions is stronger for U.S. companies, where there was less regulatory push.[8] In fact, when limiting the sample to European firms, we observe a statistically significant relationship between green patents and green revenues, but we do not find any strengthening of this relationship after the Paris Agreement.

The third channel we explore is the role played by institutional investors in pushing firms to go green. The green transition may require investors to align their portfolios with environmental goals outlined in the Paris Agreement, the novel EUTSF, or other legislation. Prior research documents that institutional shareholder activism can be associated with increases in operating performance (Denes et al., 2017), and there has also been evidence of ESG-oriented activism by institutions (Dimson et al., 2015; Dyck et al., 2019; Krueger et al., 2020; Dimson et al., 2021). We first examine whether there is evidence of higher green revenues post-Paris in firms in which more institutional shareholders are present before the passage of the Agreement. The focus of institutional ownership pre-Paris intends to rule out that our results are driven by institutional investors' portfolio adjustments as a reaction to the Paris Agreement. We document that there is some association between stronger pre-Paris presence of institutional owners and the ramp up of green revenues post-Paris. We estimate that a standard deviation higher level of institutional ownership at the signing of the Paris Agreement is associated with an about 0.7 percentage points higher green revenue share afterwards. Next, we focus on the role of responsible and climate-aware investors, which we measure by the extent to which the equity of the firm is held by signatories of the Principles for Responsible Investment (PRI)

[8] Our study does not measure the impact of the subsequent government support programs such as the landmark 2022 US Inflation Reduction Act which might have produced effects only after the end of our sample period.

(Gibson Brandon et al., 2022) and the CDP (Atta-Darkua et al., 2022). We find evidence that a stronger presence of CDP institutions is associated with more green revenues after the Paris Agreement. In a last cross-sectional test, we evaluate if the horizon of institutional investors plays a role in shaping firms' transition to greener business models. Using average portfolio churn measures at the firm-level (see Gaspar et al. (2005); Starks et al. (2017)), we find that firms that are owned more heavily by long-term investors prior to the Paris agreement, tend to generate higher green revenues afterwards, but only when we use a stricter definition of green revenues based on the different GRCS tiers. This evidence suggests that there could be a trade off between short-term (financial) goals of companies and possibly costly longer-term objectives in terms of firms' transitioning to greener activities. Our findings speak more broadly to the larger debate around the impact of engagement and exit strategies (Berk and Van Binsbergen, 2021; Edmans et al., 2022; Heath et al., 2023; Hartzmark and Shue, 2022; Becht et al., 2023).

Another equally important question addressed in this study is: What have been the financial returns of the corporate shift to green business activities thus far? Just because firms have commercialized green products and services, it does not necessarily imply that these efforts have a positive effect on a firm's profitability or that they have generated a good return on the invested capital and firm resources used to undertake the transition. Green business activities could be profit-driven if it creates new market opportunities for firms, or if green product differentiation can be passed on to customers with green preferences. This is consistent with our evidence above that institutional ownership plays a role in the promotion of green revenues. However, it could also be the case that green products and services entail lower profit margins or higher capital investments, resulting in net costs associated with shifting to green solutions, at least in the short-run. This presents a potential trade-off between the social benefits of environmental performance and stock performance. Interestingly, our estimations reveal that firms with lower ROA and higher CAPEX generate higher green revenues, indicating that there are possible upfront costs associated with generating green revenues. The evidence of long-term oriented institutional investors playing a role also points in this direction.

To better understand the financial consequences of green revenues, we focus our analysis on the stock market performance of firms with higher green revenues. While we replicate some of the FTSE Russell green revenues index series' outperformance, we find that there is no overall green "alpha" over the full sample period once we account for exposures to systematic asset pricing factors. However, there is some evidence of alpha for portfolios of green firms (i.e. those with high levels of green revenues) in the period after the Paris Agreement when attention to environmental issues is heightened. This result seems to be concentrated only in US stocks and we do not observe green alpha for European stocks. We conclude that the market favorably received the green transition by US companies that had more flexibility to adopt green products voluntarily, as opposed to European firms, which might have been more compelled to act due to regulatory pressure. In additional tests on the financial performance of firms with green revenues, we also examine whether firms with higher green revenues show higher positive earnings surprises. This investigation aims to determine if the observed outperformance of green US stocks post-Paris is due to unexpectedly high cash flows from greener firms. We fail to find such evidence, even among firms with the highest shares of green revenues following the Paris Agreement, which is preliminary evidence that any observed alpha is due to investors discounting green stocks differently and not because they are surprised by their actual earnings.

Our study contributes to the finance literature examining the implications of climate change and environmental concerns. Prior studies have examined carbon emissions (Bolton and Kacperczyk, 2021, 2023; Ilhan et al., 2021; Aswani et al., 2024), industrial pollution (Hsu et al., 2023) or measures of environmental performance from ESG ratings (Pastor et al., 2022; Karolyi et al., 2023; Alves et al., 2023; Eskildsen et al., 2024; Berg et al., 2022a). Most of these studies tend to use either the "E" component of ESG ratings or firms' carbon footprints based on Scope 1 and 2 emissions. These measures reflect mostly firms' past operations or conduct. In contrast, the green revenues measure we use in this paper is more forward-looking focusing on the "solution" or product side. It better captures the extent to which the usage of a firm's output contributes to addressing climate change or environmental degradation and how a firm can benefit commercially from a shift to a greener economy.

A second stream of literature to which our paper offers a contribution are studies examining green patents and R&D (Cohen et al., 2023; Hege et al., 2022; Bolton et al., 2022). In our paper, we take the extra step to examine whether green inventions translate into the actual adoption of those technologies and whether firms achieve higher commercial revenues as a result. Interestingly, we find that incumbent energy companies, despite holding green patents (Cohen et al., 2023), do not seem to generate more green revenues which speaks to the disconnect in this important sector. The transition to green appears to be driven by new companies outside the traditional energy sector.

A third research stream is on the existence of a green alpha in stock returns. Our tests suggest that the green alpha is concentrated on a subset of US firms and, in additional tests, we find no average earnings surprises for firms with green revenues suggesting that the observed alpha might come from a discount rate effect rather than an excess cash flow effect. These finding are related to the literature examining whether investors are willing to pay more for holding green securities.[9]

Finally, we also provide novel evidence on the impact of public policies that establish taxonomies for firms' sustainable activities in order to direct private capital to support the green transition. More recently, there have been several papers that have looked at the EU policy frameworks, for instance Hoepner et al. (2023), Sautner et al. (2022), Dai et al. (2023), Lambillon and Chesney (2023), or Scheitza and Busch (2024). While the EU taxonomy is only starting to be implemented, in our study we are able to test whether–in the past–firms started to shift towards taxonomy-aligned business activities, what drives such shifts, and how stock markets started to price these green revenues.

[9]Pastor et al. (2021) and Zerbib (2022) shed light on mechanisms whereby environmental preferences can create a "taste" premium in green stocks. Heeb et al. (2023) present experimental evidence suggesting that investors are willing to pay to be aligned with their sustainable preferences. Other studies demonstrate significant variability in greenium estimates across municipal and corporate bond markets. These estimates range from zero (Larcker and Watts, 2020), to relatively small (e.g., -8 bps in Caramichael and Rapp (2022), -6 bps in Baker et al. (2018), and -2 bps in Zerbib (2019)), to substantial, for instance, -63 bps in Colombage and Nanayakkara (2020)). Furthermore, Karpf and Mandel (2018) and Flammer (2021) elicit factors beyond environmental preferences that influence greenium estimates, such as issuance size, issuer creditworthiness and credibility, as well as noise in ESG ratings.

2 Data and Variables

Our sample comprises publicly listed firms in FactSet Fundamentals with a minimum market capitalization of USD $100 million and domiciled in the 48 countries that are classified as developed or emerging markets by FTSE Russell for which we have data coverage for our main variable on green revenues. We get annual company financials and monthly stock prices from FactSet Fundamentals. The sample period stretches from 2008 to 2022 and the companies in our sample represent more than 90% of global total market capitalization.

2.1 Green Revenues

Our main variable of interest is *Green Revenues %* – i.e., the percentage of revenues a company derives from "green" products and services.[10] The data source is FTSE Russell (now an LSEG Business), the leading global index provider, which developed a methodology to measure how firms' revenues are shifting towards a low carbon economy. FTSE Russell's Green Revenues Classification System (GRCS) provides firm-level revenue exposure to environmentally sustainable business activities for over 16,000 publicly-listed firms. The GRCS taxonomy comprises 10 green sectors and 64 sub-sectors based on their impact on climate change mitigation and adaptation, water, resource use, pollution, and agricultural efficiency (see Table A.1 in the Appendix for more details). In the main analysis, the sample includes 33,170 firm-year observations where green revenues are larger than 0. In total, 3,321 unique firms exhibit green revenues at some point over the sample period from 2008 to 2022.

This classification system was originally developed by FTSE Russell with Impax Asset Management and responded to investor demand for tracking the performance of the green economy and to construct financial products that sought exposure to it (such as the FTSE Russell's Environmental Markets Index Series). More recently, investors have started to use this data also for regulatory reporting requirements such as the the eligibil-

[10] A few papers have used this novel dataset on firm green revenues - (Kruse et al., 2020; Bassen et al., 2023; Lel, 2024).

ity of sustainable activities for the EUTSF that was adopted in 2020. In fact, the GRCS was used by the European Commission's Joint Research Center in its impact assessment report of the EUTSF and has shaped the proposal from the EU High-Level Expert Group on Sustainable Finance, indicating a significant alignment between the GRCS and the EU taxonomies (in subsequent sections, we show how our main results are robust using instead the EUTSF). At the core of the EUTSF are six climate and environmental goals: (1) climate change mitigation, (2) climate change adaptation, (3) sustainable use and protection of water and marine resources, (4) transition to a circular economy, (5) pollution prevention and control, and (6) protection and restoration of biodiversity and ecosystems. Similar to other taxonomies, the EUTSF considers a business activity as "green" if it positively contributes to one of the goals without harming any of the other environmental objectives.[11]

The GRCS data shows that more than 3,000 companies generate revenues from green products and services. FTSE Russell uses three methods to calculate green revenues:

1. **Disclosed**: Less than a third of the GRCS data comes directly from detailed publicly disclosed information (company websites, annual reports, CSR or sustainability reports, etc.) where company-reported business segments are mapped into the GRCS classifications of business activities. This is followed by semantic screening of keywords (ex: "biofuel" or "electric vehicles") and FTSE Russell analysts then verifying a company's involvement in green products or services.

2. **Company-specific estimates**: This is the case when FTSE Russell analysts start with other available non-revenue data (e.g. production volumes, market shares of a product, etc.) and then engage directly with companies to confirm the estimates on the breakdown of revenues by green activity.

3. **Sector-specific estimates**: This occurs for companies with known green revenues

[11] The roll out of the EU taxonomy occurs after our sample period ends. Starting in 2022, financial institutions offering investment products in the EU were required to report to what extent their portfolios were taxonomy-aligned. In 2023 EU banks started to disclose lending indicators directly related to the Taxonomy. Over the coming years, large EU firms will be required to disclose information about their taxonomy-aligned activities. The EU has also set up the International Platform on Sustainable Finance to map common agendas and promote consistency across the emerging national taxonomies.

but no available public disclosures. In this case FTSE Russell uses a quantitative model that takes reported data from sector peers to estimate a firm's revenues from each GRCS green sector. The approach of estimating green-revenue exposure is akin to carbon emissions data used by other data providers such as S&P Trucost, which is also commonly estimated and used frequently in the academic literature (e.g., Bolton and Kacperczyk (2021) and many other papers).

The GRCS Green Revenues 2.0 data model was launched in 2020 and provides point estimate data for *Green Revenues %* since 2016. It builds on earlier versions going back to 2008 that provided only upper and lower bounds of estimated green revenues. We consulted with FTSE Russell on how to backfill estimates from 2016 going back to 2008. Starting in 2016, FTSE Russell provides both point estimates as well as a confidence interval of green revenues for each firm. The lower bound is a conservative estimate and the upper bound a more optimist view on the green revenues of a company. For the period before 2016, FTSE Russell did not provide point estimates, but only confidence intervals going back to 2008. Based on the information provided to us by FTSE Russell, we computed a factor that allows to us to backfill the point estimates using the minimum and maximum green revenues in the data. The factor is obtained by calculating

$$Factor_{i,2016} = \frac{GR_{i,2016} - GR_{i,min,2016}}{GR_{i,max,2016} - GR_{i,min,2016}} \tag{1}$$

where $Factor_{i,2016}$ is the factor of firm i in 2016, $GR_{i,2016}$ is the point estimate, $GR_{i,min,2016}$ the lower bound and $GR_{i,max,2016}$ the upper bound. We backfill this factor for the years 2008 to 2015. To obtain the point estimate for years before 2016, we apply the formula

$$GR_{i,t} = GR_{i,min,t} + Factor_{i,2016} \times (GR_{i,max,t} - GR_{i,min,t}) \tag{2}$$

where $GR_{i,t}$ is the new point estimate, $GR_{i,min,t}$ the lower bound in a given year between 2008 and 2015 and $GR_{i,max,t}$ the upper bound, respectively.

Table A.2 in the Appendix provides the top companies ranked by green revenues per geographical region. For each of the top countries, we provide details on the five firms with the highest USD amounts in green revenues according to the FTSE Russell GRCS data. The table shows many global leaders in energy, mostly in terms of generation from renewable and alternative energy sources (nuclear: Electricité de France; wind: EnBW; hydro: Electrobras; solar: Canadian Solar), as well as well as firms providing equipment (Hanwha) and firms enabling efficiencies via IT processes (e.g., Amazon and Microsoft with cloud computing) or buildings management and power storage. A second main category is transportation that minimises the environmental impacts such as electric road vehicles (Tesla, BYD, or Toyota Motor) as well as railways manufacturer (Alstom) or operators (China Railway). Finally, the table provides some examples of firms active in environmental resources, namely providers of key raw minerals and metals for the energy transition (SQM for lithium), sustainable forestry, waste management, or water infrastructure. In our analyses, we consider the active discussion on whether several technologies should be labelled as green or not. A prominent example is nuclear energy, which is free of emissions, but has other environmental risk associated with it.[12] To tackle this concern in our paper, we use alternative definitions of green revenues excluding controversial technologies to alleviate concerns that the results might be driven by exactly these divisive green revenues.

To check whether this new data offers new information on the green transition, we explore the correlations of green revenues with other measures of environmental sustainability previously used in the finance literature. Those include corporate carbon emissions and environmental scores and ratings. There are several reasons to believe that green revenues are different from those other measures. First, green products and services are not necessarily related to the greenness of a firm's production and business operations. For example, the environmental efficiency in the production of cars is different from the environmental footprint of the cars once they are used. Second, environmental scores mostly measure how firms implement or manage environmental issues, which is more related to their conduct rather than their products. It is easy to envision firms that have good best-in-class environmental scores but sell products and services with a negative

[12] See, for example, https://www.reuters.com/business/sustainable-business/eu-parliament-vote-green-gas-nuclear-rules-2022-07-06/.

environmental impact (e.g., oil companies). The new green revenues measure that we use captures a firm's contribution to the green transition through its products. Third, we computed the correlations between green revenues with E-scores from MSCI, a modified version proposed in Pastor et al. (2022) as well as levels and intensities of firms carbon emissions (see e.g. Bolton and Kacperczyk (2021) or Bolton and Kacperczyk (2023)). Table 2 shows that these commonly used measures have low correlations with the share of a firm's green revenues. From this preliminary analysis we conclude that, indeed, green revenues provide novel insights into how firms contribute to the green transition.

2.2 Green Patents

To gauge how green products and services, and ultimately green revenues are associated with green patents, we gather data from the Global Corporate Patent Dataset (GCPD) developed by Bena et al. (2017).[13] Following prior literature, we measure granted green patents based on the technology classes that are classified by the OECD as related to the environment following the mapping outlined in Haščič and Migotto (2015). This definition of green patents has been used in academic studies such as Cohen et al. (2023), Hege et al. (2022) and Atta-Darkua et al. (2022). After categorizing green patents held by each publicly-listed firm, we construct the variables *GP Indicator* and *GP Ratio* per firm, calculated as a dummy variable if the firm had at least a green patent pre-Paris and also the ratio of green patents to total patents granted. In cases of missing firm data, we impute zeros. This measure spans from 2008 to 2013 due to a lag until filed patents are approved and incorporated into the last update of the GCPD database. While we take granted green patents as a measure of successful technological innovation we acknowledge its limitations as firms may strategically choose not to patent all inventions and the propensity to patent with the USPTO varies across industries or geographies.

[13] This data is available at https://patents.darden.virginia.edu/.

2.3 Institutional Ownership

Institutional investors play an increasingly important role in global capital markets. We access data on institutional ownership from the FactSet/LionShares database which has global coverage (Ferreira and Matos (2008)) and consider in particular if an institutional investor has signed the United Nations' sponsored Principles for Responsible Investment (PRI, the world's largest initiative on ESG investing) and the CDP (formerly the Climate Disclosure Project and now focused on tackling also other environmental goals such as water, forests or plastics). We use the data from Gibson Brandon et al. (2022) and Atta-Darkua et al. (2022) who matched the institution names in FactSet with the list of signatories from the PRI and CDP websites. Those papers find that PRI signatories who incorporate ESG into their active equity holdings have better portfolio ESG scores than non-PRI signatories (but less so for US-domiciled institutions) and that CDP signatories decarbonize their portfolios faster. A related paper by Pastor et al. (2023) also finds that after institutions become PRI signatories, their ESG portfolio tilts tend to become "greener" (and that this is more the case for European institutions than US ones).

3 Sizing the Green Economy

As a first step, we quantify the size of the green economy in terms of corporate revenues generated from environmentally sustainable activities. Companies without any green revenue are categorized as having zero contribution. This classification aligns with the methodology adopted by FTSE Russell in their research reports, wherein missing green revenue data is interpreted as zero. We use a revenue-weighted metric to represent aggregate global revenues in US dollars and also as a percentage of total firm revenues. Figure 1 illustrates aggregate green revenues in trillions of USD on the left axis, alongside the percentage of total revenues on the right axis. Both absolute and relative measures of green revenues exhibit an upward trend over the period of analysis, exceeding $4 trillion and 6.5% of total revenues by 2022. Notably, this increase accelerates post-2016, coinciding with the Paris Agreement entering into force, which stands as the most significant global initiative aimed at achieving net zero emissions. Figure 2 offers a more detailed view by showcasing the distribution of green sales across the 10 GRCS sectors. Notably, the largest portions come from green energy (management, generation and equipment) and transportation (solutions and equipment).

We further investigate whether the green economy is concentrated in a few countries. Figure 3 shows that the US is the leading country with one trillion dollars in terms of USD green revenues. Table A.2 shows that about a good fraction comes from the top three companies: Amazon, Tesla and Microsoft. It is not surprising that in the Asia-Pacific region green revenues are also concentrated around the large economies of China and Japan. In Europe, green revenues tend to be more evenly distributed compared to Asia and North America. More importantly, the bottom panel of Figure 3 brings to light that relative to the size of the overall economy, Europe has on average a much larger percentage share in green revenues compared to other regions in the world. By 2022 there were already multiple European economies where the green economy makes up more than 10% of total revenues, whereas for example the US only had a green share of approximately 5%. In conclusion, while North America and Asia-Pacific have more total green revenues, Europe's economy has transitioned more toward green revenues in relative terms.

Another interesting pattern emerges from the distribution of green revenues across various industries. We calculate USD and percentage green revenues for each Factset industry. Figure 4 illustrates that no singular industry dominates the landscape. Naturally, certain sectors, such as Health Services, exhibit small to negligible green revenue contributions. Conversely, the Manufacturing and Utilities sectors collectively contribute approximately 1.4 trillion USD in green revenues, while the Consumer Durables sector (largely comprising electric vehicles), adds another 0.5 trillion USD in green revenues. Within these industries, the green revenue share ranges from around 14% for Consumer Durables to up to 22% in Utilities. These results suggest that the transition towards environmentally sustainable products and services is not confined to a single or a few industries; rather, it manifests across diverse sectors.

We have established the green revenue share across the industries the firms operate in. However, this characterization may offer an incomplete understanding of the green corporate landscape. Instead of solely assessing green revenues based on traditional industry affiliation, we now delve into the green industry breakdown by business activities that is used by FTSE Russell. The GRCS green revenues classification divides firms' green revenues into distinct business activities. For instance, while Tesla's primary revenue source is electric vehicle sales, the company also generates some revenue from efficient power storage solutions. Figure 5 offers a more detailed view by showcasing the distribution of green revenues across the 64 GRCS sub-sectors showing again that the largest portion of green business activities originates from energy management, generation, and equipment. This delineation between traditional sectors and GRCS green business activities proves significant, as the allocations exhibit fundamental differences.

4 Drivers of the Green Economy

Given the growth in the green economy we documented in the prior sections, we now turn to the underlying drivers fueling this transition. We test three drivers of the green transition: (1) the role of public policies, particularly the regulatory push towards sustainable finance in Europe post Paris; (2) the importance of corporate innovation to overcome technological limitations; and (3) the contribution of institutional investors, their alignment with ESG and climate initiatives, as well as their investment horizon.

In Table 1 we show descriptive statistics of our sample. The pooled equal-weighted average firm has about 3.6% of green revenues (this is lower than the revenues-weighted averages shown in the previously discussed figures). The divergence between equal- and revenue-weighted average green revenues suggests that green revenues tend to be higher amongst larger firms. Relative to the Paris Agreement, our sample is balanced with about half of the observations falling before and half after the Paris Agreement (2008-2015 and 2016-2022). In terms of the geographic distribution, half of the firm-year observations fall into the region of Asia Pacific, 20% originate from North America, 16% from Europe and the remainder from firms that are located in the rest of the world.

4.1 The Paris Shock

We exploit the unexpected success of the 2015 United Nations Climate Change Conference, which led to the Paris Agreement — an international commitment by 196 nations worldwide to reduce greenhouse gas emissions and enhance resilience to climate change. The conference took place in December 2015 and the Agreement entered into force on November 4, 2016. Among other objectives, the primary pledge is to limit the increase in the global average temperature to 1.5 degrees Celsius compared to pre-industrial levels. Tangible actions include the mobilization of funding aimed at reducing greenhouse gas emissions. Investments in more efficient resource utilization and green technologies are pivotal components of the Paris Agreement.

Importantly, this shock was far from anticipated. In fact, many articles were pessimistic about the outcome of the conference given the rather unsuccessful track record of prior climate negotiations.[14] Nonetheless, it received a lot of attention beforehand, and its importance was equally highlighted across various articles. The uncertain outcome of the meeting provides us with a quasi-exogenous shock to expected beliefs about climate action. Indeed, Ramadorai and Zeni (2024) show in a survey that managers believe that the Paris Agreement increased the likelihood of more stringent environmental legislation worldwide. Seltzer et al. (2022) exploit the same shock in their study and elicit that the Paris Agreement had a sizable impact on bond prices and risk. Engle et al. (2020) show that their climate attention index spiked during the Paris meeting, indicating a sharp increase in attention to issues related to climate change and, more broadly, environmental challenges. While the Agreement certainly increased the likelihood of future climate-related regulations, we believe that an equally significant consequence of the Paris Agreement was to systematically elevate the importance and awareness of environmental issues among various economic agents, such as consumers, firms, investors, and regulators.

[14]Examples of article headlines before the meeting included "The Paris Climate Summit Will Fail, For A Pretty Simple Reason" by Forbes or "Paris climate summit: Don't mention Copenhagen" by the BBC.

Hence, the Paris shock is an interesting setting to use in a cross-sectional difference-in-differences research design to explore the three channels that could potentially lead to more corporate green revenues. One could also see our econometric design leveraging the Paris Agreement as a Bartik style (or shift share) analysis. In a sense, the Paris Agreement serves as the "shift", and predetermined characteristics (e.g., Pre-Paris green patents) as the "shares". Bartik instruments help to overcome several challenges associated with low-frequency data, such as accounting variables. In our regression analyses, both the main dependent and independent variables are observed on an annual basis, making the use of a Bartik instrument appealing.

Among others, Goldsmith-Pinkham et al. (2020) highlight that Bartik instruments are suitable in empirical setups where firms have differential exogenous exposures to a common shock. The new regime of heightened environmental awareness due to the success of the Paris Agreement was unanticipated and therefore provides us with a reasonably quasi-exogenous shock. Our research design exploits this feature and employs several predetermined variables to estimate the effect of (1) the region in which the firm is domiciled, (2) firms' green innovative capacities measured by their green patents held before the Paris Agreement and (3) institutional ownership characteristics of firms measured before the Paris meeting in 2015.

Instead of using time-varying exposure variables for the full sample period, our difference-in-differences regressions keep the exposure before the common shock constant over time to estimate how the common shock affects firms' green revenues conditional on pre-shock differences. In several robustness checks, we relax this assumption and employ time-variant variables. More details regarding the conditions under which the Bartik approach provides consistent estimates are outlined in papers such as Goldsmith-Pinkham et al. (2020) and Breuer (2022).

4.2 The Role of Regulation

With the introduction of the EUTSF, an unprecedented framework was established to delineate criteria for investments to qualify as "green". A green activity is defined as one that contributes positively to at least one of the six EU environmental objectives without causing harm to any of the others.[15] This regulatory push stands out prominently among other European initiatives aimed at promoting green investing, such as Article 173 (Ilhan et al., 2023) in France or mandatory greenhouse gas (GHG) disclosures in the UK (Downar et al., 2021; Jouvenot and Krueger, 2019). While these efforts have been hailed as significant milestones, a crucial question remains: do green public policies effectively lead to greener outcomes? We aim to tackle this question by examining whether regions with more stringent green regulations, particularly Europe, exhibit different responses compared to the rest of our sample.

In this first regulatory channel, we examine the effects of three pivotal milestones in the progression towards the implementation of the EUTSF. Phase 1 commenced post-Paris, where the EU launched a call for applications in 2016 to establish an expert group commissioned to develop the first large-scale taxonomy on sustainable investing. Phase 2 started in 2018 when the Technical Expert Group convened for the first time to commence work on developing the taxonomy. Two years later, in 2020, the EUTSF was finalized and formally enacted. We study the impact of each phase independently as well as in combination. We employ the following regression model:

$$\begin{aligned} GR_{i,t} = \alpha + \beta_1 Post_t + \beta_2 Europe_i + \beta_3 Post_t \times \ Europe_i \\ + \beta_n X_{i,t} + \mu_j + \tau_t + \epsilon_{i,t}, \end{aligned} \tag{3}$$

where $Post_t$ is an indicator equal to 1 if the year is either ≥ 2016 for the post Paris period, ≥ 2018 for the creation of the TEG, or ≥ 2020 following the launch of the EUTSF in 2020. The variable $Europe_i$ is an indicator variable equal to 1 of the firm's headquarter is based in Europe, μ_j are sector fixed effects and τ_t time fixed effects. We also control

[15]The EU Taxonomy on Sustainable Finance (Regulation (EU) 2020/852 and from here referred to as the *EUTSF*). (see `https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en`) At the core of the EUTSF are six environmental goals. Those are (1) climate change mitigation, (2) climate change adaptation, (3) sustainable use and protection of water and marine resources, (4) transition to a circular economy, (5) pollution prevention and control, and (6) protection and restoration of biodiversity and ecosystems. In its novel approach, the EUTSF considers an investment as "green" if it positively contributes to one of the goals without harming any of the other environmental objectives.

for several firm characteristics and accounting variables contained in the vector $X_{i,t}$. The dependent variable is $GR_{i,t}$, i.e., the percentage green revenue share of company i in year t.

Table 3 shows that European firms, on average, exhibit significantly higher green revenue shares than firms domiciled in other regions. More importantly, in the post-Paris era, that share increased faster across Europe compared to the rest of the sample. We observe an uptick post-Paris (column 1), which becomes even more pronounced following the creation of the Technical Expert Group (TEG) (column 2), and later upon the official enactment of the taxonomy (column 3). Moreover, the findings indicate that the most rapid acceleration occurred between 2018 and 2020 (column 4), suggesting that firms were able to anticipate the roll out of the EUTSF. The economic magnitude is significant as firms based in Europe exhibit on average 1.4 percentage points higher green revenues, which is equivalent to 10% of one standard deviation change in green revenues.

We conduct several robustness checks to ensure the reliability of our findings. Initially, we were concerned that our results might be influenced by firms incorporated in European countries outside the European Union, such as Norway, Switzerland, and the UK. However, excluding firms from these nations did not significantly alter our results. It's worth noting that the UK remained part of the EU for several years post-Brexit and thus still engaged in the green taxonomy.

Another concern pertains to the definition of the dependent variable. There remains ongoing debate among policymakers whether investments in sectors such as nuclear energy should be deemed "green".[16] To address this concern, we excluded controversial technologies such as nuclear power generation and focused only on tier 1/2 green revenues that have clear net benefits to the environment according to the FTSE Russell GRCS (Panel B in Table 3). FTSE Russell splits green business activities into 133 micro sectors and allocates each of them into either tier 1 (significant and clear environmental benefits), tier 2 (activities with more limited but net positive environmental benefits) or tier 3 (with some environmental benefits but overall net neutral or negative)[17] and

[16] see e.g. `https://bit.ly/3vcANLk`

[17] The methodology is outlined here: FTSE Russell Green Revenues Classification.

then further restrict to revenues which are aligned with the standards of the EUTSF (Panel C in Table 3).[18] To be aligned with the EUTSF, the technology is required to contribute positively to one of the six environmental pillars outlined in the taxonomy without causing harm to another. Even after these adjustments, our results remain consistent. Lagging the control variables also does not alter the results significantly (Table I.A.3). Lastly, we observe in Table I.A.6 that firms in Europe generate more USD green revenues post Paris, however, the results tend to be slightly less significant than the baseline results with green revenue shares. One possible interpretation of weaker treatment effects when using dollar green revenues as the dependent variable (Table I.A.6) is that the EU regulation resulted in European firms substituting non-green revenues to green revenues rather than growing overall revenues through incremental green revenues from new products and services.

Furthermore, we considered the possibility that European firms may differ in observable characteristics, prompting us to employ a matching approach. For this purpose, we conduct a propensity score matching approach using both kernel and nearest neighbor matching. The findings remain unchanged, reinforcing our conclusion that more stringent regulation seems to accelerate the transition toward a green economy.

4.3 The Role of Green Innovation

Our second test is to assess whether a firm's pre-Paris green innovative capacity is associated with stronger green revenues. We perform the following OLS regression

$$GR_{i,t} = \alpha + \beta_1 PostParis_t + \beta_2 GPRatio_{i,preParis} + \beta_3 PostParis_t \times \ GPRatio_{i,preParis} + \beta_n X_{i,t} + \mu_j + \tau_t + \epsilon_{i,t}, \tag{4}$$

where $GR_{i,t}$ is the percentage green revenue share of company i in year t. $PostParis_t$ is an indicator variable equal to 1 if the year is larger or equal to 2016. $GPRatio_{i,preParis}$

[18] The mapping of green revenues into the EUTSF is available here: Green Revenues EUTSF.

is the average ratio of green over total patents between the years 2008 to 2013 that a company created. We also estimate a specification in which we code a dummy variable that identifies firms that had at least one green patent prior to the Paris Agreement. We control for several firm characteristics $X_{i,t}$. Our regressions additionally include sector and year-fixed effects in the form of μ_j and τ_t, respectively. Standard errors are clustered at the country level.

Table 4 reveals that companies that were more innovative and held more green patents before 2016 generated higher green revenues post Paris. The baseline findings indicate that companies with a higher number of green inventions were more apt to transition at a faster pace. We acknowledge that some sectors and firms are generally more predisposed to patent their innovations and therefore implement a ratio of green over total patents as main measure. Moreover, to address the possibility of a single (or a few) green patents being highly influential, we also implement an indicator variable equal to 1 when a firm created a green patent in any year between 2008 and 2013 (see column 1). We end in 2013 since the green patent data is not yet available beyond 2013. As an additional robustness check, we utilize the count of green patents without adjusting for total patents generated by a firm. Across all specifications, our analysis suggests that increased green innovation enables firms to respond to the shock of the Paris Agreement, as evidenced by the positive coefficients of the interaction terms. The specification in column (1) using the $GP\ Indicator$ variable is particularly useful in evaluating the economic magnitude of the effect. Looking at the coefficient for the interaction effect $Post\ Paris \times GP\ Indicator$, we find that firms with at least one green patent before the Agreement experienced an average increase of 2.8 percentage points in green revenues after the Agreement came into effect. The effect is economically meaningful and represents about 20% of the standard deviation of the green revenue share.

We further split the sample by regions and zoom into the energy sector, which could arguably play a crucial role in the transition. The difference between the US and Europe is striking (columns (3) and (4) of Table 4). In both regions, green innovation is correlated with more green revenues. Yet, only in the US the Paris shock led to a disproportional increase in green revenues for firms holding relatively more green patents after the Paris Agreement. One interpretation is that European firms were already more prepared and therefore the Paris Agreement did not impact them as much as US companies. Previous finding by Cohen et al. (2023) suggest that firms in the energy sector hold over-proportionally more green patents. We therefore test whether intangible green capital translates into more tangible outcomes in the Energy sector. Column (5) shows that energy companies do not generate more green revenues despite their green patents. There are several plausible explanations for this result. First, the transition for formerly brown firms might be slow since it requires a fundamental change in their business orientation. Second, green patents could be used by energy firms to preempt new (green) competitors from entering the market.

Similar to the tests for the regulation channel in the previous subsection, we replace the dependent variable with tier 1/2 and EUTSF green revenues (Panels B and C of Table 4). We observe that the results tend to be even stronger. In fact, firms that held at least one green patent before the Paris Agreement, had on average 3.7 percentage points more green revenues that qualify under the EUTSF after the Agreement. Lagging the control variables in Table I.A.4 does not change our findings. Table I.A.7 reveals that innovative firms also exhibit higher dollar green revenues post Paris, which indicates that firms holding green patents do both replace existing “brown” revenues with green alternatives, but also grow their total dollar green revenues. The pattern for the innovation channel is markedly different here when compared to the more muted effect of regulation in growing dollar green revenues.

4.4 The Role of Institutional Investors

Prior research (Dyck et al., 2019) suggests that institutional investors push firms to improve their ESG profiles. In a similar spirit, survey evidence by Krueger et al. (2020) finds that institutional investors indeed care about climate risk. Apart from institutional investors’ direct preferences for ESG, institutions might also care about firms’ green revenues for purely financial reasons. We now explore whether and how institutional ownership relates to firms' green revenues. We also test how *green/responsible institutional ownership*–which has increased significantly over the recent past with initiatives such as the PRI (Gibson Brandon et al., 2022) or the CDP (Atta-Darkua et al., 2022) becoming more prominent in financial markets–is associated with green revenues. In this section we also conduct tests that exploit the differences in institutional investor horizons (Starks et al., 2017).

It is challenging to establish a causal relationship in this part of the analysis since a link between (responsible, climate-aware and long-term) institutional investors and green revenues could be interpreted in two ways. On the one hand, investors might engage with firms to encourage more green investing. On the other hand, investors with green mandates (e.g. ESG mutual funds) pick stocks to "green their portfolios". To better isolate selection versus influence effects, we follow Ilhan et al. (2021), and set up a regression model where (responsible) institutional ownership is predetermined, that is, we consider a firm's institutional ownership share before the Paris shock in 2015 and keep it constant in the post-Paris period. While imperfect, this approach allows us to reasonably rule out that the results are driven by institutional investors changing their holdings after the Paris Agreement.

In Table 5, we investigate the link between institutional ownership pre-Paris and green revenues after the Paris Agreement. We find that firms that exhibited higher institutional ownership around the signing of the Paris Agreement indeed show higher green revenues afterwards. In column (2), we observe that firms held by PRI signatory institutions tend to exhibit higher green revenues but do not observe a significant acceleration in green revenues following the Paris Agreement. However, we observe that firms held by CDP member investors exhibit on average higher green revenue shares and the acceleration post Paris is faster compared to other companies (column 3). Lastly, in column (4), we test whether firms held by "patient" investors (as proxied by lower portfolio turnover), generate more green revenues. In Panel B, restricting again to revenues from tier 1/2 business activities or EUTSF compatible revenues, we find a highly significant negative link between high turnover rates (short horizons) and green revenue shares. These results are reminiscent of previous findings in Starks et al. (2017) that focus on ESG ratings and investor horizons. We find the link between long-term oriented institutional owners and green revenues particularly interesting since the evidence suggests that there might be important inter-temporal trade offs. In other words, it is likely that there are important costs in the short-run to set up firms for the green transition (which short-term investors dislike), and benefits only accrue in the long-run. The estimated coefficients for ROA and CAPEX in Table 3 also suggest potential short-term costs of the transition.

We conduct several robustness tests. The lagged regression results in Table I.A.5 are similar to the contemporaneous findings. Firms held by (responsible) institutional investors also have more green dollar revenues (see Table I.A.8). We further employ a regression model where institutional ownership is time-varying and this analysis corroborates the previous findings.

Pertaining to all three channels of this study, we examine which GRCS sectors drive our results. Figure 2 indicates that the Energy Management sector experiences the most significant growth following the Paris Agreement. Excluding revenues from this sector weakens our findings considerably. We then systematically exclude each GRCS business activity one by one. Omitting any of the nine other activities has little to no impact on our results. Hence, it appears that solutions such as energy storage, smart grids, and efficient IT processes are crucial drivers of the energy transition.

5 Do Investors Value Green Revenues?

A shift to more environmental sustainability is a desirable goal in itself. Yet, it remains an open question whether the market values firms with more green revenues and whether it is possible to generate profitable trading strategies from investing in green firms. We create four portfolios and plot their cumulative raw returns from the beginning until the end of our sample period in Figure 6. As a benchmark, we plot cumulative returns for all stocks in our sample. Next, we split the sample and divide it into three green subsamples based on the magnitude of green revenue shares. To examine the role of different "shades of green", we choose the same 20% and 50% revenue cutoffs as FTSE Russell in their indices and observe a positive monotonic relationship between cumulative portfolio returns and green revenues. The all green revenues portfolio does not outperform the all stocks portfolio, but portfolios with higher green revenue shares appear to be associated with higher cumulative returns over the sample period. Do these seemingly higher returns reflect alpha or might they just capture asset pricing factors commonly used in the finance literature?

In Table 6, we test the *Green Revenues* > 20% portfolio with several standard asset pricing models from Jensen et al. (2023). In the CAPM, the observed alpha is positive but insignificant. That result holds across all models that we employ. The *Green Revenues* > 20% portfolio significantly loads on the market portfolio. The negative loading on value indicates that green stock returns are mostly driven by growth stocks. Overall, we can conclude that significant positive alphas are unattainable between 2008 and 2022 through investing into green revenue stocks. We test alternative specifications with different green revenues % cutoffs to be included in the green portfolio. The results are very similar to the findings presented in Table 6. The simple CAPM explains most of the abnormal returns and the loadings on the market portfolio are consistently positive and significant at the 1% level. The value factor continues to load negatively on the green portfolio. Size, momentum and profitability remain mostly insignificant.

We know from the previous analyses that green revenues were relatively flat until the Paris Agreement. Thus, in Table 7, we extend the analysis and split the sample into two periods: pre- and post Paris Agreement, for each of the portfolios. In the last column of Table 7, we consider a specification including "pure play" firms that have more than 80% green revenues in the first year they occur in our sample. The idea is to examine the financial implications of firms that were created with the primary purpose to sell predominantly green products and services. In addition to that, we also examine US and European firms separately. Lastly, we focus on a sample comprising global energy stocks.

In the full sample we observe a positive and significant alpha post Paris for stocks with higher green revenues. This result seems to be driven by US stocks whereas profitable strategies including European green firms seem impossible. In the energy sector, there were no firms with more than 50% in green revenues, however, the portfolio of firms with *Green Revenues* $> 20\%$ outperformed in the post Paris period. The "pure plays" strongly outperform the benchmark post Paris, and on average, even over the whole sample period. This result is particularly pronounced in the US. In a nutshell, before the implementation of the Paris Agreement, profitable trading strategies based on green revenues were unattainable. After 2016, this seemed to have changed, but not everywhere in the world. The results on the financial profitability of investing into firms with (high) green revenues remain mixed, but if anything, portfolios with extreme green revenues shares appear to be most promising.

Last but not least, we explore whether investors are surprised by the earnings of greener companies. Any observed alpha could be due to investors' mispricing of stocks with high green revenues. They might have underestimated these firms' earnings and learn about the financial performance after the earnings announcement. If that were the case, investors would update their beliefs regarding the financial strength of green firms, buy more stocks with high green revenues and therefore drive up the stock price. In this case, any alpha is explained by unexpectedly high *cash flows*. However, if a green alpha is observed and investors correctly anticipated the earnings, then the outperformance is more likely driven by investors who *discount* the expected green cash flows differently. Table 8 supports the latter explanation as investors are on average not surprised by the cash flows of green firms.

We conduct a series of robustness checks to ensure the validity of our findings. Initially, we address concerns regarding the potential influence of a small number of firms on green portfolio returns. Previous studies, such as Bessembinder (2018), have demonstrated that a handful of highly impactful stocks often account for the majority of the equity premium. Specifically, large firms with substantial green revenues may significantly drive the observed green alpha in our value-weighted portfolios. Examining Table I.A.2, it becomes apparent that Tesla comprises approximately 50% of the green US portfolio considering stocks with more than 50% in green revenues. This raises questions regarding the robustness of our results when Tesla's influence is omitted.

Indeed, Figure I.A.1 shows that a significant portion of the initially observed green outperformance can be attributed to the returns of Tesla. However, notably in the US post-Paris period, we continue to observe a positive and statistically significant alpha generated by the green portfolio containing stocks with more than 50% green revenues. This finding is further substantiated in Table I.A.9. In Panels A and B, Tesla is excluded from the value-weighted global and US portfolios, respectively. Panels C and D present equally weighted portfolios, effectively mitigating the influence of outlier firms with high market capitalization. Despite these adjustments, the results consistently indicate a positive and significant green alpha post-Paris in the US for stocks with at least 50% green revenues. The other portfolios neither under- nor outperform, suggesting that investors do not need to sacrifice returns to invest in firms generating green revenues.

6 Conclusions

In this paper, we use data on green corporate revenues to provide novel evidence on the green transition, which accelerated after the Paris Agreement. We find that regulatory initiatives have led to an acceleration in the growth of the green economy in Europe. We show that innovative US firms possessing green patents can effectively translate these patents into tangible green revenues, which also contributes to the transition. Finally we document that the presence of institutional owners is associated with the post-Paris shift to green. We also examine the stock returns of firms with high green revenues and find only modest evidence of a green alpha, which is concentrated in US stocks in the post-Paris period. Our paper leaves many questions open for future research. For example, how much has the shift to green actually contributed to reducing greenhouse gas emissions or achieving broader environmental goals?

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Figure 1. The Growth of the Green Economy

This figure illustrates the growth of corporate revenue exposure to the green economy. The left axis shows the total annual revenues derived from green products and services for publicly-listed companies worldwide (in USD trillions). The right axis shows the percentage of green revenues relative to total company revenues. The data comes from FTSE Russell's Green Revenues Classification System (GRCS), which identifies products and services that positively impact climate change mitigation and adaptation, water management, resource use, pollution reduction, and agricultural efficiency.

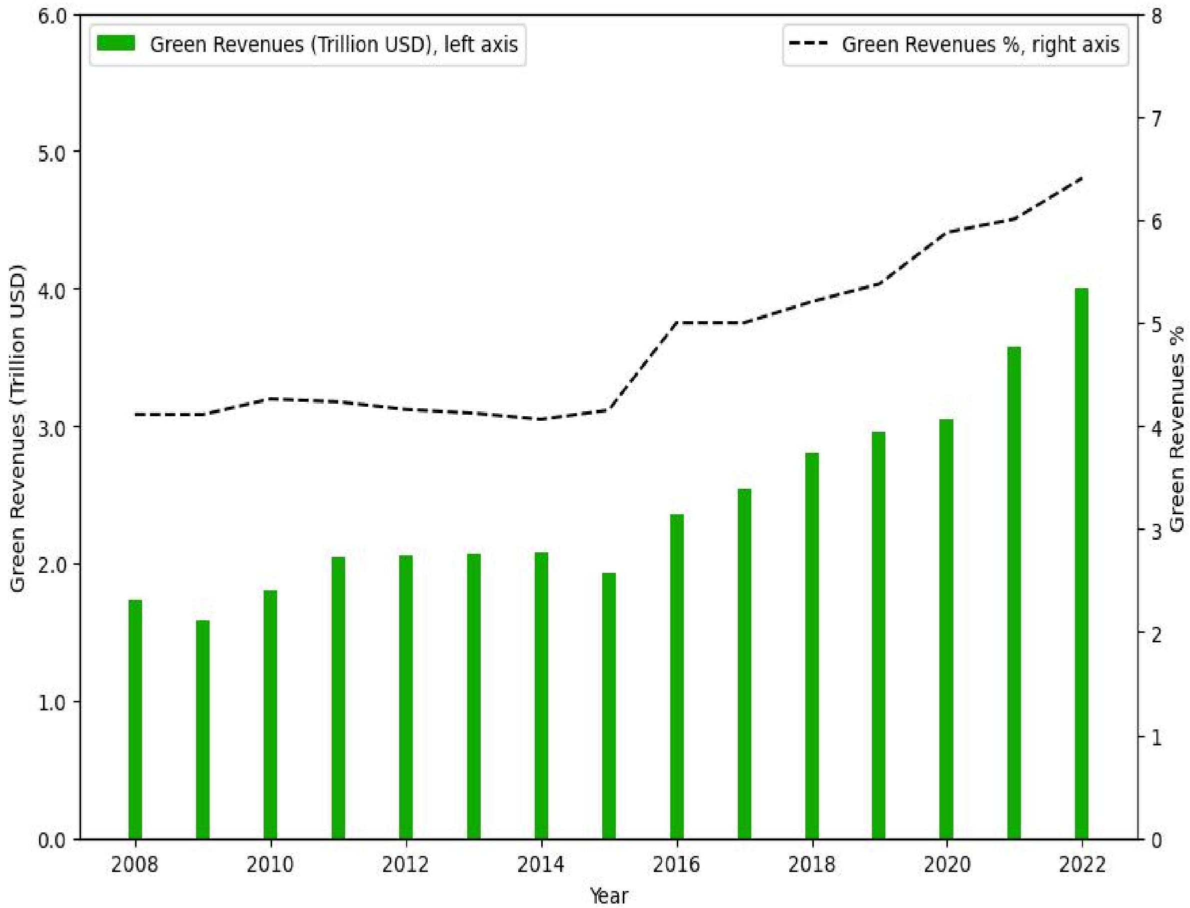


Figure 2. Green Revenues by Business Activity

This figure shows the growth of revenues by type of green business activity based on FTSE Russell's Green Revenue Classification System (GRCS). The graph plots the percentage of green revenues in each of the 10 GRCS green sectors relative to total revenues per year. More details on the GRCS taxonomy system are provided in Table A.1.

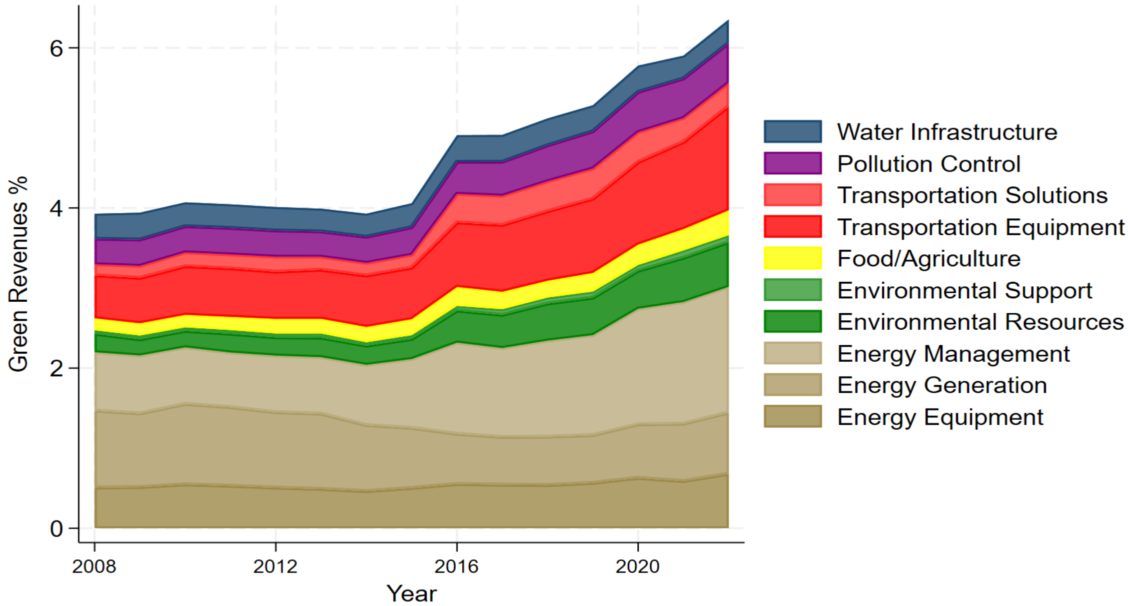


Figure 3. Green Revenues by Country

This figure shows the annual revenues from green products and services by geographical regions based on each company's country of incorporation at the end of the sample period (2022). The top graph shows total annual green revenues (in USD $ trillions) while the bottom graph shows the percentage share of green revenues relative to total revenues for companies in each country, respectively.

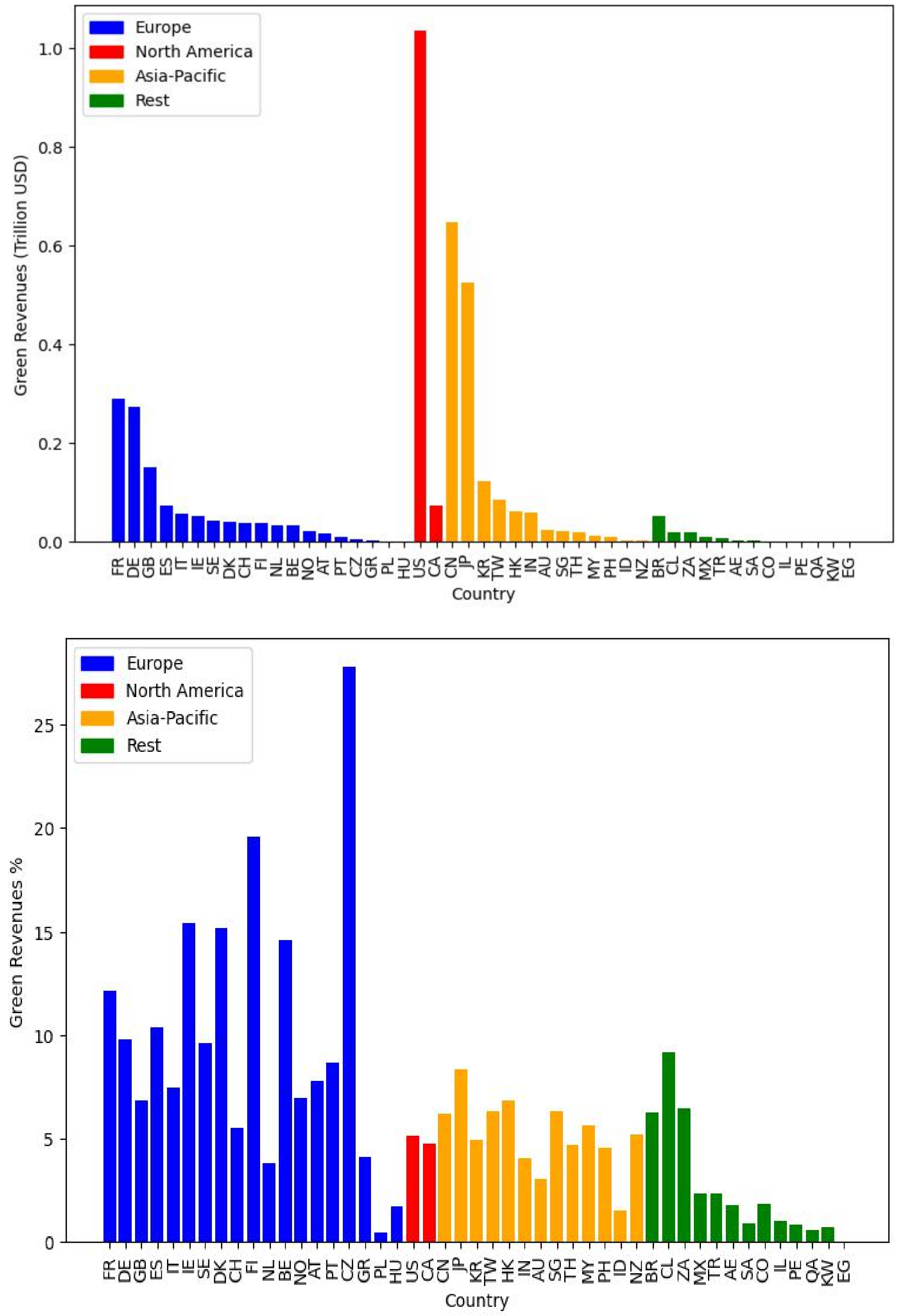


Figure 4. Green Revenues by Industry

This figure maps green revenues into different traditional industries based on a company's Factset sector classification at the end of the sample period (2022). The green bar chart shows total annual green revenues (in USD $ trillions) and the black dashed line plots green revenues relative to total revenues for companies in each industry.

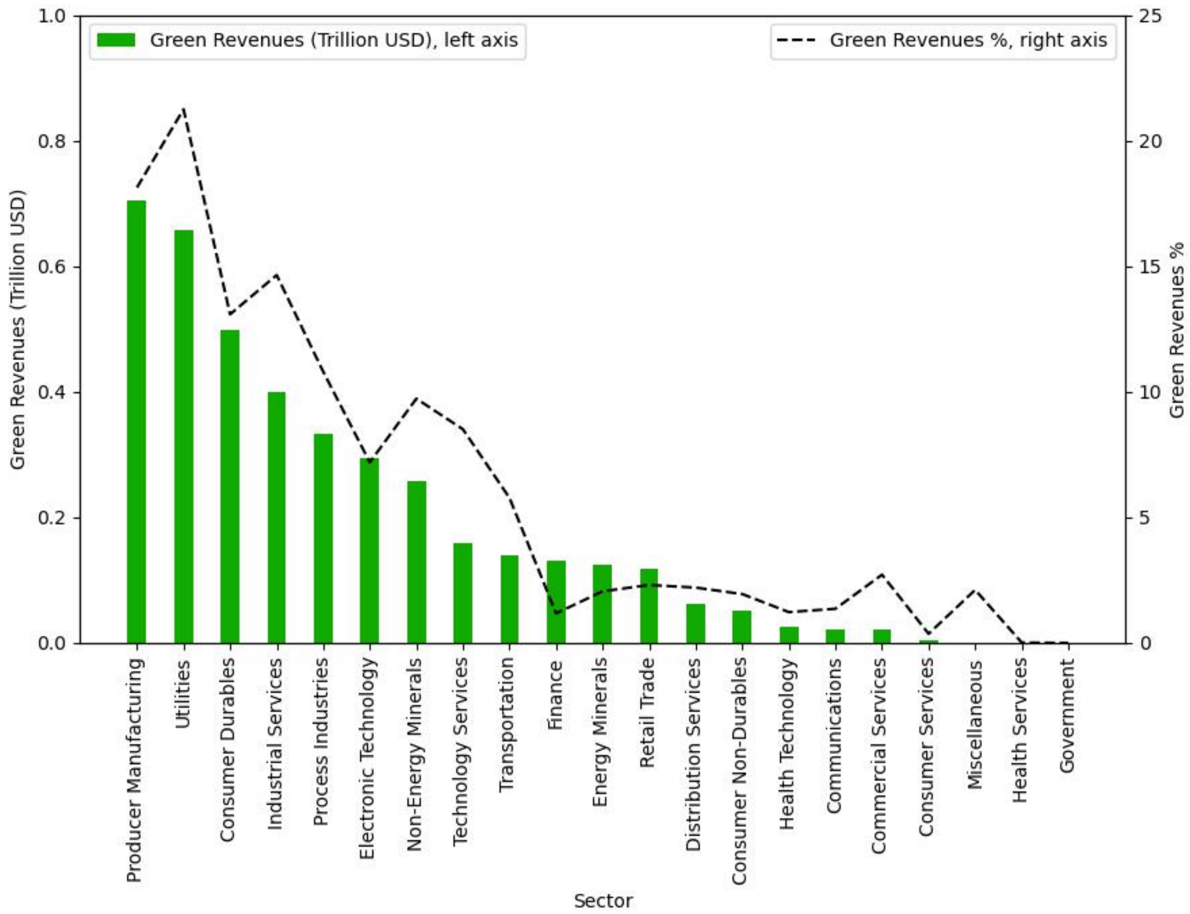


Figure 5. Decomposition of Green Revenues by Business Activity

The tree map breaks down total 2022 green revenues based on the 10 GRCS green sectors (and into the 64 GRCS subsectors) of FTSE Russell's Green Revenue Classification System (GRCS). Total green revenues sum to approximately USD $4 trillion in 2022. More details on the GRCS taxonomy system are provided in Table A.1.

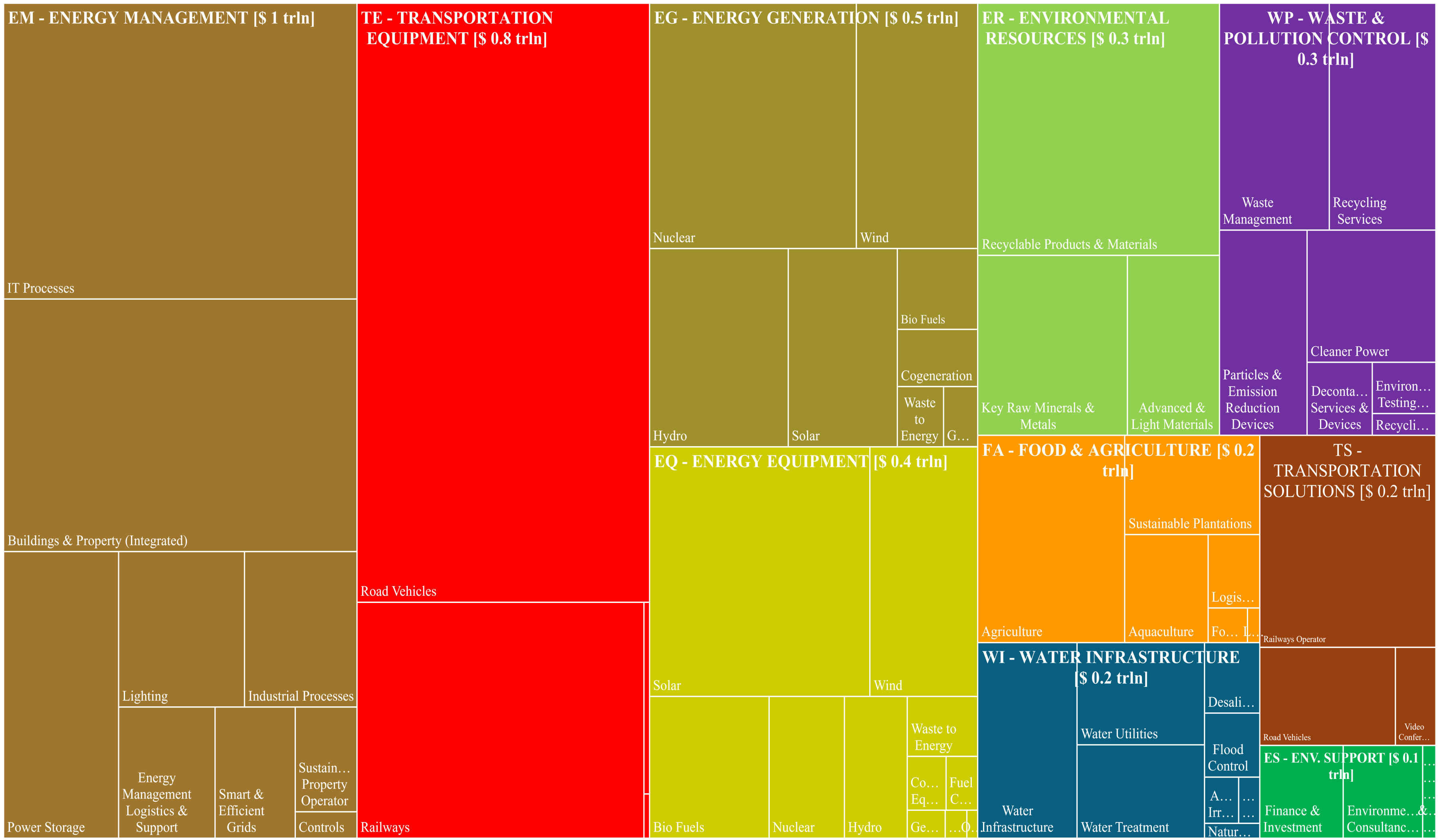
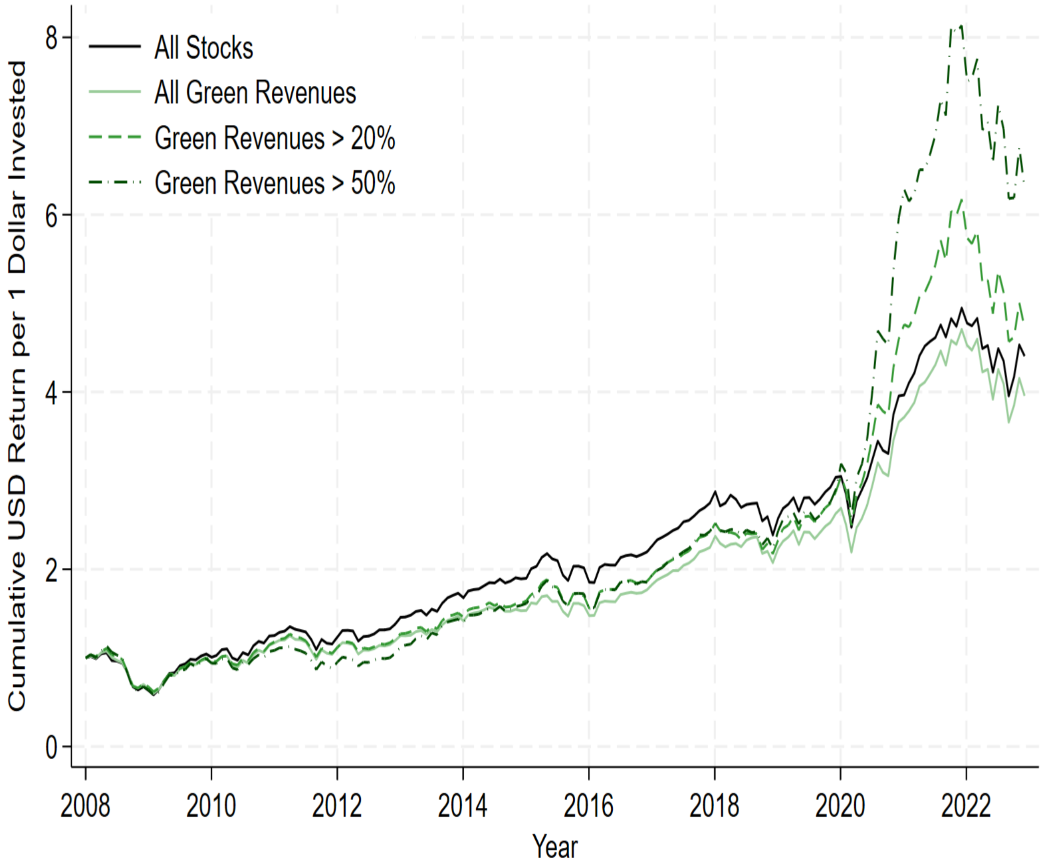


Figure 6. Green Revenues Portfolio Returns

We plot cumulative returns per 1 USD invested for the value-weighted green stocks portfolio (light green) and contrast it with portfolios containing stocks with at least 20% (dashed green) and 50% (dashed darker green) green revenues, respectively. The black line plots cumulative returns for the portfolio including all stocks in our sample and serves as a benchmark.



Tables

Table 1. Summary Statistics

This table provides summary statistics for the main variables used in the regression analysis. Detailed definitions of the variables are provided in Table A.3. Continuous variables are winsorized at the 1% and 99% levels.

Variable	N	Mean	Median	SD	Min	Max
Green Revenues %	224,571	3.630	0.000	14.403	0.000	100.000
Green Revenues Tier 1/2	224,571	3.188	0.000	13.354	0.000	100.000
Green Revenues EU	224,571	2.625	0.000	11.812	0.000	100.000
Green Revenues > 0	224,571	0.148	0.000	0.355	0.000	1.000
Post Paris	224,571	0.505	1.000	0.500	0.000	1.000
Post TEG	224,571	0.356	0.000	0.479	0.000	1.000
Post EUTSF	224,571	0.211	0.000	0.408	0.000	1.000
All Patents	224,571	2.691	0.000	14.016	0.000	109.500
GP	224,571	0.153	0.000	0.902	0.000	7.333
GP Ratio	224,571	0.007	0.000	0.036	0.000	0.277
GP Indicator	224,571	0.037	0.000	0.169	0.000	1.000
Sales ($ Million)	224,571	2277.32	417.79	6118.60	1.25	57104.00
Tobin's Q	224,571	1.979	1.362	1.850	0.553	17.395
Leverage	224,571	0.238	0.213	0.195	0.000	0.852
ROA	224,571	0.066	0.064	0.096	-0.474	0.403
Cash	224,571	0.173	0.121	0.168	0.000	0.842
Capex	224,571	0.043	0.028	0.049	0.000	0.349
R&D	224,571	0.016	0.000	0.040	0.000	0.293
Europe	224,571	0.164	0.000	0.370	0.000	1.000
North America	224,571	0.203	0.000	0.402	0.000	1.000
Asia-Pacific	224,571	0.557	1.000	0.497	0.000	1.000
Rest of World	224,571	0.089	0.000	0.285	0.000	1.000
IO	204,130	0.208	0.083	0.280	0.000	1.000
IO CDP	204,130	0.071	0.022	0.102	0.000	1.000
IO PRI	204,130	0.078	0.025	0.118	0.000	1.000
IO Turnover	192,169	0.266	0.218	0.1494	0.001	1.735

Table 2. Correlation with Other Environmental Measures

Below the diagonal, this table shows pairwise Pearson correlation coefficients for % company green revenues and various environmental measures that have been used extensively in the finance literature. These include scope 1, 2, and 3 carbon intensities from Trucost and environmental (ESG) scores from MSCI. *E-Score PST* is the modified environmental score proposed in Pastor et al. (2022), and *Ad. ESG Score* is the industry-adjusted ESG score from MSCI. Above the diagonal, the table shows Spearman correlation coefficients. All correlation coefficients are significant at the 1% significance level. The number of pairwise observations is in parentheses.

Variables	% Green Revenues	CO2 Int. Scope 1	CO2 Int. Scope 2	CO2 Int. Scope 3	E-Score PST	Ad. ESG Score
% Green Revenues	1.00	0.23	0.09	0.29	-0.22	0.14
	(249,033)	(82,230)	(82,230)	(82,230)	(24,424)	(24,424)
CO2 Int. Scope 1	0.04	1.00	0.55	0.68	-0.59	-0.03
	(82,230)	(82,230)	(82,230)	(82,230)	(15,072)	(15,072)
CO2 Int. Scope 2	0.01	0.07	1.00	0.44	-0.37	-0.02
	(82,230)	(82,230)	(82,230)	(82,230)	(15,072)	(15,072)
CO2 Int. Scope 3	0.06	0.25	0.07	1.00	-0.53	0.04
	(82,230)	(82,230)	(82,230)	(82,230)	(15,072)	(15,072)
E-Score PST	-0.12	-0.36	-0.17	-0.50	1.00	0.23
	(24,424)	(15,072)	(15,072)	(15,072)	(57,582)	(57,582)
Ad. ESG Score	0.08	-0.10	-0.01	-0.01	0.28	1.00
	(24,424)	(15,072)	(15,072)	(15,072)	(57,582)	(57,584)

Table 3. The Role of the Regulatory Push

In this table, we estimate the effect of increased green regulation on firm *Green Revenues %*. We split the sample into firms incorporated in *Europe*, where a strong regulatory push occurred after the Paris Agreement, and the rest of the sample comprised of countries with less green regulation. *Post Paris* is a dummy equal to 1 if the year $\geq$ 2016. *Post TEG* is equal to 1 if the year $\geq$ 2018, where *TEG* indicates the creation of the Technical Expert Group commissioned to create the EU green taxonomy. *Post EUTSF* is equal to 1 if the year $\geq$ 2020, where *EUTSF* stands for the EU Taxonomy on Sustainable Finance that was rolled out in 2020. In Panel A, the dependent variable is corporate % green revenues as defined by the FTSE Russell GRCS. In Panel B, we only consider tier 1/2 green revenues as the dependent variable. According to the FTSE Russell GRCS, tier 1/2 restricts green revenues from green products & services to those with an overall net positive impact on the environment and excludes controversial technologies such as nuclear. In Panel C, we employ an even stricter definition of green revenues following the EU Taxonomy, which requires that a technology positively contributes to one of the six environmental goals outlined in the EUTSF without harming any over the other goals. By *, **, and *** we denote *p*-levels below 10%, 5%, and 1%, respectively. Standard errors clustered on the country level are in parentheses.

Regression	(1)	(2)	(3)	(4)
		Panel A: Green Revenues %		
Europe	0.790**	0.916**	1.092**	0.790**
	(0.377)	(0.389)	(0.410)	(0.377)
Europe x Post Paris	1.200**			0.579
	(0.457)			(0.371)
Europe x Post TEG		1.342***		0.566***
		(0.430)		(0.142)
Europe x Post EUTSF			1.394***	0.551**
			(0.484)	(0.266)
ln(Sales)	0.983***	0.983***	0.983***	0.983***
	(0.121)	(0.121)	(0.121)	(0.121)
Tobin's Q	0.166***	0.165***	0.167***	0.165***
	(0.0324)	(0.0327)	(0.0327)	(0.0326)
Leverage	-0.280	-0.286	-0.287	-0.287
	(0.446)	(0.446)	(0.447)	(0.444)
ROA	-5.547***	-5.529***	-5.526***	-5.536***
	(1.259)	(1.254)	(1.254)	(1.254)
Cash	-0.763	-0.765	-0.768	-0.767
	(0.640)	(0.641)	(0.642)	(0.639)
Capex	7.815***	7.835***	7.859***	7.816***
	(2.294)	(2.292)	(2.285)	(2.297)
R&D	2.757	2.775	2.765	2.770
	(3.645)	(3.642)	(3.650)	(3.639)
Constant	-2.226*	-2.224*	-2.231*	-2.222*
	(1.254)	(1.252)	(1.257)	(1.252)
Observations	224,571	224,571	224,571	224,571
R-squared	0.066	0.066	0.066	0.066
		Panel B: Green Revenues % Tier 1/2		
Europe	0.599*	0.714**	0.877**	0.599*
	(0.304)	(0.318)	(0.339)	(0.303)
Europe x Post Paris	1.124***			0.525*
	(0.369)			(0.298)
Europe x Post TEG		1.268***		0.535***
		(0.354)		(0.146)
Europe x Post EUTSF			1.332***	0.550**
			(0.401)	(0.237)
Observations	224,571	224,571	224,571	224,571
R-squared	0.065	0.065	0.065	0.065
		Panel C: Green Revenues % EU Taxonomy		
Europe	0.551**	0.665**	0.806***	0.550**
	(0.255)	(0.261)	(0.279)	(0.255)
Europe x Post Paris	1.010***			0.524*
	(0.349)			(0.296)
Europe x Post TEG		1.106***		0.410***
		(0.321)		(0.140)
Europe x Post EUTSF			1.166***	0.488**
			(0.362)	(0.216)
Observations	224,571	224,571	224,571	224,571
R-squared	0.062	0.062	0.062	0.062
Controls	YES	YES	YES	YES
Sector Fixed Effect	YES	YES	YES	YES
Year Fixed Effect	YES	YES	YES	YES
Country Cluster	YES	YES	YES	YES

Table 4. The Role of Green Innovation

This analysis aims to explore the heterogeneity in green corporate innovation before the Paris Agreement and how it impacts green revenues generated through the sales of green products and services. In Panel A, we test whether corporate green innovation measured by the variable *GP Indicator*, which is equal to one if a company had at least one green patent between 2008 and 2013, impacts the sales of green products and services captured by the variable *Green Revenues %*. Alternatively, *GP Ratio* measures average annual green patents relative to all patents created by a company between 2008 and 2013. *Post Paris* is a dummy equal to 1 if the year $\geq$ 2016. We interact *GP Ratio/Indicator* with *Post Paris* to explore how firms with heterogenous levels of green innovation are differently prepared for a green transition after the Paris Agreement. In Panel B, we only consider tier 1/2 green revenues as the dependent variable. According to the FTSE Russell GRCS, tier 1/2 restricts green revenues from green products & services to those with an overall net positive impact on the environment and excludes controversial technologies such as nuclear. In Panel C, we employ an even stricter definition of green revenues following the EU Taxonomy, which requires that a technology positively contributes to one of the six environmental goals outlined in the EUTSF without harming any over the other goals. By *, **, and *** we denote *p*-levels below 10%, 5%, and 1%, respectively. Standard errors clustered on the country level (exception in column (3)) are in parentheses.

Regressions	(1)	(2)	(3)	(4)	(5)
			Panel A: Green Revenues %		
GP Indicator	6.520**				
	(2.464)				
GP Indicator x Post Paris	2.774***				
	(0.335)				
GP Ratio		44.91***	63.15***	33.73**	5.597
		(11.87)	(1.747)	(13.79)	(5.006)
GP Ratio x Post Paris		14.91***	14.50***	4.591	0.704
		(1.980)	(2.578)	(6.149)	(8.488)
Observations	224,571	224,571	38,064	36,783	7,085
R-squared	0.072	0.081	0.131	0.092	0.041
			Panel B: Green Revenues % Tier 1/2		
GP Indicator	5.182***				
	(1.657)				
GP Indicator x Post Paris	3.687***				
	(0.640)				
GP Ratio		35.06***	48.77***	28.46**	5.624
		(8.392)	(1.638)	(12.62)	(4.873)
GP Ratio x Post Paris		19.10***	22.28***	2.155	-4.688
		(3.224)	(2.417)	(6.230)	(5.184)
Observations	224,571	224,571	38,064	36,783	7,085
R-squared	0.071	0.078	0.112	0.087	0.035
			Panel C: Green Revenues % EU Taxonomy		
GP Indicator	3.669***				
	(1.128)				
GP Indicator x Post Paris	3.845***				
	(0.690)				
GP Ratio		23.66***	29.91***	25.11*	5.917
		(4.753)	(1.492)	(13.73)	(4.986)
GP Ratio x Post Paris		19.95***	23.10***	2.649	0.457
		(3.645)	(2.201)	(6.505)	(8.449)
Observations	224,571	224,571	38,064	36,783	7,085
R-squared	0.067	0.071	0.092	0.088	0.042
Controls	YES	YES	YES	YES	YES
Sample	GLOBAL	GLOBAL	USA	EUROPE	ENERGY
Sector Fixed Effect	YES	YES	YES	YES	NO
Year Fixed Effect	YES	YES	YES	YES	YES
Country Cluster	YES	YES	NO	YES	YES

Table 5. The Role of Institutional Investors

In this table, we explore the role of institutional shareholders in the green transition. In Panel A, the dependent variable is *Green Revenues %* and the main explanatory variables are the total share of institutional ownership (*IO*), the share of responsible institutional ownership (*IO PRI*) and climate-focused institutional ownership (*IO CDP*) in the year 2015, which we keep constant over the sample period in our main regression setup to explore how institutional ownership pre-Paris influenced firm green revenues post Paris. *Post Paris* is a dummy equal to 1 if the year $\geq$ 2016. Institutional ownership is considered green when institutional investors are signatories of the Principles of Responsible Investing (*IO PRI*) and climate-related when the institutional owner is part of the Carbon Disclosure Project (*IO CDP*). *IO Turnover* measures the holdings-weighted Churn ratio of institutional owners by firm. In Panel B, we only consider tier 1/2 green revenues as the dependent variable. According to the FTSE Russell GRCS, tier 1/2 restricts green revenues from green products & services to those with an overall net positive impact on the environment and excludes controversial technologies such as nuclear. In Panel C, we employ an even stricter definition of green revenues following the EU Taxonomy, which requires that a technology positively contributes to one of the six environmental goals outlined in the EUTSF without harming any over the other goals. By *, **, and *** we denote *p*-levels below 10%, 5%, and 1%, respectively. Standard errors clustered on the country level are in parentheses.

Regression	(1)	(2)	(3)	(4)
Panel A: Green Revenues %				
IO	2.095***			
	(0.231)			
IO x Post Paris	2.309***			
	(0.669)			
IO PRI		8.599***		
		(0.657)		
IO PRI x Post Paris		1.570		
		(1.332)		
IO CDP			7.816***	
			(0.768)	
IO CDP x Post Paris			5.860***	
			(1.897)	
IO Turnover				-1.806
				(1.585)
IO Turnover x Post Paris				-1.602
				(0.959)
Observations	204,130	204,130	204,130	192,169
R-squared	0.070	0.072	0.072	0.071
Panel B: Green Revenues % Tier 1/2				
IO	1.624***			
	(0.203)			
IO x Post Paris	2.484***			
	(0.619)			
IO PRI		6.835***		
		(0.698)		
IO PRI x Post Paris		2.512**		
		(1.174)		
IO CDP			6.004***	
			(0.821)	
IO CDP x Post Paris			6.496***	
			(1.730)	
IO Turnover				-1.513
				(1.178)
IO Turnover x Post Paris				-1.926***
				(0.707)
Observations	204,130	204,130	204,130	192,169
R-squared	0.070	0.071	0.071	0.070
Panel C: Green Revenues % EU Taxonomy				
IO	0.989***			
	(0.159)			
IO x Post Paris	2.498***			
	(0.539)			
IO PRI		4.782***		
		(0.537)		
IO PRI x Post Paris		3.456***		
		(0.984)		
IO CDP			4.187***	
			(0.687)	
IO CDP x Post Paris			6.933***	
			(1.457)	
Turnover				-1.356
				(1.046)
Turnover x Post Paris				-1.762***
				(0.637)
Observations	204,130	204,130	204,130	192,169
R-squared	0.065	0.067	0.067	0.066
Controls	YES	YES	YES	YES
Sector Fixed Effect	YES	YES	YES	YES
Year Fixed Effect	YES	YES	YES	YES
Country Cluster	YES	YES	YES	YES

Table 6. Green Revenues Portfolios: Returns and Factor Loadings
We compare monthly raw cumulative value-weighted green returns in column (1) with excess green returns (*Alpha*) adjusted for various asset pricing factors in columns (2)-(5). Monthly returns are from 2008 until 2022. The green testing portfolio includes firms with *Green Revenues* > 20%. Column (2) shows the results for the CAPM model. Column (3) implements the Fama-French 3-factor model. Column 4 employs the Carhart 4-factor model and in column 5 we add the profitability factor. By *, **, and *** we denote *p*-levels below 10%, 5%, and 1%, respectively. Robust standard errors are in parentheses.

Portfolio	*Green Revenues* > 20%				
Regression Model	(1) Raw	(2) CAPM	(3) FF3	(4) Carhart	(5) 5 Factors
Alpha	0.907**	0.0338	0.0134	0.0220	0.0122
	(0.392)	(0.109)	(0.0990)	(0.0994)	(0.119)
Market		1.016***	1.068***	1.065***	1.066***
		(0.0238)	(0.0237)	(0.0263)	(0.0280)
Size			-0.0147	-0.0178	-0.00467
			(0.0657)	(0.0671)	(0.0998)
Value			-0.254***	-0.267***	-0.264***
			(0.0433)	(0.0627)	(0.0657)
Momentum				-0.0244	-0.0248
				(0.0763)	(0.0762)
Profitability					0.0286
					(0.155)
Observations	180	180	180	180	180
R-squared	0.000	0.922	0.937	0.937	0.937

Table 7. Green Revenues Portfolios: Alphas by Level of Greenness

In this table, we aim to examine how different shades of green are valued by the market and whether different tierings based on the level of "greenness" result in a green *Alpha*. We further split the sample into two periods. *Pre Paris* includes all years from 2008 to 2015 and *Post Paris* considers the time period from 2016 to 2022. We calculate monthly value-weighted portfolio returns and regress them on the 5-factor model as proposed in Table 6 in column 5. The first green portfolio includes all stocks with *Green Revenues* > 0% (column (1), the second portfolio includes stocks with *Green Revenues* > 20% (column 2), the third portfolio considers stocks with *Green Revenues* > 50% (column 3), and the portfolio of "pure play" firms includes stocks with *Green Revenues* > 80% (column 4) in the year when the firm first entered the sample. Panel A uses the full global sample. Panel B restricts to US firms and Panel C limits the sample to European firms. Lastly, Panel D employs a global sample of firms operating in the energy sector. By *, **, and *** we denote p-levels below 10%, 5%, and 1%, respectively. Standard errors are in parentheses.

Regression	(1)	(2)	(3)	(4)
Variable	Green Revenues %			
Portfolio	> 0%	> 20%	> 50%	> 80%
Panel A: All Firms				
Alpha	-0.101	0.0122	0.204	0.629*
	(0.0843)	(0.119)	(0.186)	(0.323)
Alpha (Pre Paris)	-0.275***	-0.240*	-0.213	-0.062
	(0.0971)	(0.126)	(0.188)	(0.285)
Alpha (Post Paris)	0.102	0.308*	0.693**	1.439***
	(0.122)	(0.178)	(0.288)	(0.523)
2008: Nr firms	1,401	485	215	134
Total USD trln	$8.3	$2.0	$0.7	$0.3
2022: Nr firms	2,693	991	499	296
Total USD trln	$29.3	$10.5	$3.9	$2.1
Panel B: US Firms				
Alpha	0.0293	0.157	0.721*	1.201**
	(0.135)	(0.189)	(0.38a)	(0.520)
Alpha (Pre Paris)	-0.220	-0.223	0.000	0.283
	(0.133)	(0.193)	(0.371)	(0.479)
Alpha (Post Paris)	0.320	0.601**	1.563**	2.273***
	(0.217)	(0.289)	(0.609)	(0.849)
Panel C: European Firms				
Alpha	-0.244**	-0.301**	-0.166	0.094
	(0.102)	(0.123)	(0.185)	(0.259)
Alpha (Pre Paris)	-0.337**	-0.558***	-0.641***	-0.071
	(0.140)	(0.145)	(0.235)	(0.348)
Alpha (Post Paris)	-0.136	-0.00494	0.380	0.286
	(0.122)	(0.173)	(0.250)	(0.358)
Panel D: Energy Firms (Global)				
Alpha	-0.0537	0.912	-	-
	(0.127)	(0.554)	-	-
Alpha (Pre Paris)	0.0697	0.195	-	-
	(0.199)	(0.600)	-	-
Alpha (Post Paris)	-0.197	1.741**	-	-
	(0.125)	(0.865)	-	-

Table 8. 1-Year Earnings Surprise

In this table, we present OLS regression results of median analyst forecast errors on lagged company % green revenues and firm controls. The earnings surprise is defined as the difference between the actual earnings and the analyst consensus, scaled by the stock price at the end of the fiscal year at time t. Forecast errors are winsorized at the 1st and 99th percentiles, respectively. The coefficients for Green Revenues %, lagged Ln(Assets) and lagged Ln(M2B) are multiplied by 100. By *, **, and *** we denote p-levels below 10%, 5%, and 1%, respectively. Standard errors, clustered on the country level for the global sample and robust standard errors for the US sample, are in parentheses.

Regression	(1)	(2)	(3)	(4)	(5)
Variables	Earnings Surprise in Year t+1				
Green Revenues %	0.001	-0.001	0.001	-0.001	0.016
	(0.002)	(0.007)	(0.002)	(0.013)	(0.017)
Lagged Ln(Assets)	0.151***	0.186***	0.125***	0.206*	0.296*
	(0.030)	(0.059)	(0.017)	(0.114)	(0.160)
Lagged Ln(M2B)	0.006***	0.010***	0.002***	0.007	0.010*
	(0.001)	(0.002)	(0.001)	(0.004)	(0.005)
Constant	-0.020***	-0.025***	-0.010***	-0.025	-0.053*
	(0.003)	(0.008)	(0.002)	(0.020)	(0.028)
Observations	101,170	3,893	25,416	975	615
R-squared	0.024	0.044	0.019	0.049	0.065
Sample	GLOBAL	GLOBAL	USA	USA	USA
Period	FULL	FULL	FULL	FULL	POST2015
Green Revenues	ANY	$\geq$ 50%	ANY	$\geq$ 50%	$\geq$ 50%
Sector Fixed Effect	YES	YES	YES	YES	YES
Year Fixed Effect	YES	YES	YES	YES	YES
Country Cluster	YES	YES	NO	NO	NO

Appendix

Table A.1. FTSE Russell's Green Revenue Classification System (GRCS)

This table provides details on FTSE Russell's Green Revenue Classification System (GRCS), which identifies green products and services covering 10 sectors and 64 subsectors. Source: FTSE Russell *"Green Revenues Data Model"*.

EG - ENERGY GENERATION	EQ - ENERGY EQUIPMENT	EM - ENERGY MANAGEMENT	ER - ENVIRONMENTAL RESOURCES	ES - ENVIRONMENTAL SUPPORT
Revenue generating activities from the generation of power from renewable and alternative energy sources.	*Revenue generating activities from the renewable and alternative energy value chain, excluding power generation activities.*	*Revenue generating activities from products and services enabling more efficient methods of energy usage and management.*	*Revenue generating activities from production, processing and sale of key and advanced materials which specifically enable the minimisation of negative environmental impacts and improve the efficiency of natural resource use*	*Revenue generating activities from environmental support services relating to consulting, investment or urban design that enable or indirectly contribute to green activities resulting in a large breadth of environmental utility*
Bio Fuels Cogeneration Clean Fossil Fuels Geothermal Hydro Nuclear Ocean & Tidal Solar Waste to Energy Wind	Bio Fuels Cogeneration Equipment Clean Fossil Fuels Fuel Cells Geothermal Hydro Nuclear Ocean & Tidal Solar Waste to Energy Wind	Buildings & Property (Integrated) Controls Energy Management Logistics & Support Industrial Processes IT Processes Lighting Power Storage Smart & Efficient Grids Sustainable Property Operator	Advanced & Light Materials Key Raw Minerals & Metals Recyclable Products & Materials	Environmental Consultancies Finance & Investment Smart City Design & Engineering

FA - FOOD & AGRICULTURE	TE - TRANSPORTATION EQUIPMENT	TS - TRANSPORTATION SOLUTIONS	WP - WASTE & POLLUTION CONTROL	WI - WATER INFRASTRUCTURE
Revenue generating activities from products that improve yield, productivity and sustainability in agriculture, silviculture, aquaculture and food production or distribution, whilst minimising negative environmental impacts	*Revenue generating activities from the provision of technologies, systems and services which minimise the environmental impacts and improve the efficiency of natural resource use associated with the transportation industry*	*Revenue generating activities from the operation of transportation solutions and services which minimise the environmental impacts and improve the efficiency of natural resource use associated with the transportation industry*	*Revenue generating activities from products and services which reduce, monitor, or prevent the contamination of air, water and soil to address global, regional and local environmental issue and technologies, systems and services for waste management, reuse and recycling*	*Revenue generating activities from technologies, infrastructure, products and services for the supply, management and treatment of water*
Agriculture Aquaculture Land Erosion Logistics Food Safety, Efficient Processing & Sustainable Packaging Sustainable Plantations	Aviation Railways Road Vehicles Shipping	Railways Operator Road Vehicles Video Conferencing	Cleaner Power Decontamination Services & Devices Environmental Testing & Gas Sensing Particles & Emission Reduction Devices Recycling Equipment Recycling Services Waste Management	Advanced Irrigation Systems & Devices Desalination Flood Control Meteorological Solutions Natural Disaster Response Water Infrastructure Water Treatment Water Utilities

Table A.2. Top Green Revenue Firms by Region

This table provides green revenues for the companies with the largest USD green revenues incorporated in the main countries for each geographical region. More details on the FTSE Russell's Green Revenue Classification System (GRCS) taxonomy system are provided in Table A.1.

Region	Country	Nr of Firms in 2008	2008 Green Revenues (in US$ trlns)	2008 Green Revenues (in %)	Nr of Firms in 2022	2022 Green Revenues (in US$ trlns)	2022 Green Revenues (in %)	TOP 1 - 5 by country COMPANY NAME Green Revenues (in US$ bln) % of Green Revenues (of which % in top FTSE GRCS sector & micro-sector)				
Europe	France	313	$ 0.280	10.0	283	$ 0.291	12.2	ELECTRICITE DE FRANCE $ 97 bln 64% (52% in EG - Nuclear)	VEOLIA ENVIRONNEMENT $ 42 bln 93% (33 % in WI - Water Utilities)	SCHNEIDER ELECTRIC $ 26 bln 72% (23% in EM - Industial Processes)	ENGIE $ 19 bln 19% (3% in EG - Solar)	ALSTOM $ 14 bln 85% (85% in TE - Trains Electric)
	Germany	289	$ 0.150	5.1	285	$ 0.274	9.8	MERCEDES-BENZ $ 30 bln 19% (15% in TE - Electrified Road Vehicles & Devices)	UNIPER $ 29 bln 10% (5% in EM - Power Storage)	E.ON $ 28 bln 23% (22% in EM - Energy Management Logistics)	EnBW $ 20 bln 35% (7% in EG - Wind)	BASF $ 20bln 22% (7% in ER - Recyclable Materials)
	U.K.	655	$ 0.112	4.8	596	$ 0.150	6.8	SHELL $ 34 bln 9% (7% in TE - Electrified Road Vehicles & Devices)	JOHNSON MATTHEY $ 21 bln 94% (76% in ER - Platinum)	BP $ 9 bln 4% (4% in TE - Electrified Road Vehicles & Devices)	ANGLO AMERICAN $ 9 bln 26% (26% in ER - Platinum)	BARRATT $ 6 bln 97% (97% in EM - Buildings & Property (Integrated))
	... others	1,267	$ 0.250	5.1	1,159	$ 0.468	9.9					
North America	U.S.	2,848	$ 0.303	2.4	2,515	$ 1.034	5.2	AMAZON $ 104 bln 20% (15% in EM - Cloud Computing)	TESLA $ 81 bln 100% (93% in TE - Electrified Road Vehicles & Devices)	MICROSOFT $ 57 bln 29% (29 % in EM - Cloud Computing)	BERKSHIRE HATHAWAY $ 28 bln 10% (7% in TS - Railways Operator)	FORD MOTOR $ 21 bln 13% (13 % in TE - Electrified Road Vehicles & Devices)
	Canada	450	$ 0.026	2.3	457	$ 0.073	4.7	CN RAILWAY $ 12 bln 91 % (91 % in TS - General Railways)	WEST FRASER TIMBER $ 9 bln 92% (92% in FA - Sustainable Forestry)	CANADIAN SOLAR $ 7 bln 100% (83% in EQ - Solar)	WASTE CONNECTIONS $ 7 bln 100% (50% in WP - Waste Management & Recycling)	CANFOR $ 5 bln 85% (85% in FA - Sustainable Forestry)
Asia Pacific	China	1,409	$ 0.047	2.7	3,383	$ 0.648	6.2	CHINA RAILWAY $ 60 bln 35% (35% in TE - Railway)	CHINA RAILWAY CONSTRUCTION $ 34 bln 21% (20% in TE - Railway)	POWER CHINA $ 25 bln 30% (8% in EQ - Hydro)	BYD $ 24 bln 38% (14% in TE - Electrified Road Vehicles & Devices)	ENERGY CHINA $ 23 bln 43% (5% in EQ - Solar)
	Japan	1,808	$ 0.370	5.7	1,956	$ 0.526	8.4	TOYOTA MOTOR $ 71 bln 30% (30% in TE - Electrified Road Vehicles & Devices)	ENEOS $ 25 bln 30% (20% in EG - Solar)	BRIDGESTONE $ 24 bln 76% (75% in TE - Energy Use Reduction Devices)	DAIKIN $ 21 bln 91% (91% in EM - Buildings & Property)	TEL $ 14 bln 94% (94% in EM - Industrial Processes)
	South Korea	345	$ 0.049	3.4	892	$ 0.123	4.9	KIA $ 17 bln 25% (25% in TE - Electrified Road Vehicles & Devices)	HYUNDAI MOTOR $ 12 bln 11% (11% in TE - Electrified Road Vehicles & Devices)	SK HYNIX $ 10 bln 28% (28% in EM - Efficient IT)	HANWHA $ 7 bln 15% (7% in EQ - Solar)	SK INNOVATION $ 8 bln 10% (5% in EM - Power Storage)
	... others	2,079	$ 0.076	3.3	3,416	$ 0.302	4.8					
Rest of the World	Brazil	169	$ 0.047	6.4	138	$ 0.052	6.2	MARFRIG $ 15 bln 58% (58% in FA - Meat & Dairy Alternatives)	GERDAU $ 14 bln 85% (85% in ER - Recyclable Materials)	SABESP $ 4 bln 88% (66% in WI -Water Utilities)	ELECTROBRAS $ 4 bln 56% (53% in EG - Hydro)	METALURGICA GERDAU $ 3 bln 20% (20% in WP - Recycling Services)
	Chile	165	$ 0.011	6.8	160	$ 0.020	9.2	SQM $ 4 bln 41% (33% in ER - Lithium)	EMPRESAS COPEC $ 4 bln 12% (12% in EA - Sustainable Forestry)	ENEL AMERICAS $ 3 bln 17% (10% in EG - Hydro)	ENEL CHILE $ 2 bln 48% (36% in EG - Hydro)	CMPC $ 2 bln 25% (15% in ER - Recyclable & Reusable Products)
	... others	1,488	$ 0.010	0.6	1,749	$ 0.046	1.7					
	Total =	13,285	$ 1.731	5.0	Total =	$ 4.008	6.9					

Table A.3. Variable Definitions and Data Sources

Variable	**Definition**
Green Revenues %	Percentage of green revenues relative to total annual company revenues, with missing values filled in as zeros (source: FTSE Russell GRCS).
Green Revenues Tier 1/2	Percentage of green revenues relative to total annual company revenues according to the tiering definition of the FTSE Russell classification system[19], with missing values filled in as zeros (source: FTSE Russell GRCS).
Green Revenues EU	Percentage of green revenues relative to total annual company revenues according to EUTSF definition of green revenues[20], with missing values filled in as zeros (source: FTSE Russell GRCS).
Post Paris	Dummy = 1 if the year $\geq$ 2016, which captures the period after the Paris Agreement.
Post TEG	Dummy = 1 if the year $\geq$ 2018, which captures the creation of the Technical Expert Group commissioned to create a taxonomy for green investing (TEG).
Post EUTSF	Dummy = 1 if the year $\geq$ 2020, which captures the roll out of the EU Taxonomy on Sustainable Finance (EUTSF).
Europe	Dummy = 1 if the company is headquartered in Europe (source: FactSet).
North America	Dummy = 1 if the company is headquartered in North America (source: FactSet).
Asia Pacific	Dummy = 1 if the company is headquartered in the Asia-Pacific region (source: FactSet).

[19] FTSE Russell Green Revenues Classification System.
[20] Green Revenues EU Taxonomy.

Table A.3 (continued): Variable Definitions

Variable	**Definition**
Rest of World	Dummy = 1 if the company is headquartered in another region (source: FactSet).
GP Ratio	Ratio of green patents to total patents between 2008 and 2013. Patent data is from the Global Corporate Patent Dataset[21] and green patents are classified using the OECD Environmental-related technology mapping developed by Hascic and Migotto (2015) and updated in 2020[22].
GP Indicator	Dummy = 1 if the company had at least one green patent between 2008 and 2013.
IO	Holdings by institutional investors as a fraction of market capitalization (source: FactSet Ownership).
IO_PRI	Holdings by institutional investors that are signatories of the Principles for Responsible Investment (PRI) as a fraction of market capitalization (sources: FactSet Ownership and Gibson Brandon et al. (2022)).
IO_CDP	Holdings by institutional investors that are participants of the Carbon Disclosure Project (CDP) as a fraction of market capitalization (sources: FactSet Ownership and CDP).
IO_Turnover	Firm-level turnover measure of institutional owners equal to the holdings-weighted Churn ratio of each institutional owner.
Sales	Total sales in millions of U.S. dollars (FactSet item *FF_SALES*).
Tobin's Q	Total assets (FactSet item *FF_ASSETS*) plus market value of equity (Factstet item *FF_MKT_VAL*) minus book value of equity (Factstet item *FF_COM_EQ*) divided by total assets.

[21] Global Corporate Patent Dataset.
[22] OECD Green Patents Classification.

Table A.3 (continued): Variable Definitions

Variable	**Definition**
Leverage	Total debt (FactSet item FF_DEBT) divided by total assets (FactSet item FF_ASSETS).
ROA	Operating income (FactSet item FF_OPER_INC) plus interest expenses (FactSet item $FF\_INT\_EXP\_DEBT$) divided by total assets (FactSet item FF_ASSETS).
Cash	Cash and short-term investments (FactSet item FF_CASH_ST) divided by total assets (FactSet item FF_ASSETS).
Capex	Capital expenditures (FactSet item FF_CAPEX_FIX) divided by total assets (FactSet item FF_ASSETS).
R&D	Research and development expenditures (FactSet item FF_RD_EXP) divided by total assets (FactSet item FF_ASSETS).
Returns	Monthly gross returns are calculated using stock prices from Factset (item ADJ_PRICE).
Market	Value-weighted returns of all firms in our sample using prices from Factset (item ADJ_PRICE).
Size	Global size factor from Jensen et al. (2023) (source: https://jkpfactors.com/).
Value	Global value factor from Jensen et al. (2023) (source: https://jkpfactors.com/).
Momentum	Global momentum factor from Jensen et al. (2023) (source: https://jkpfactors.com/).
Profitability	Global profitability factor from Jensen et al. (2023) (source: https://jkpfactors.com/).

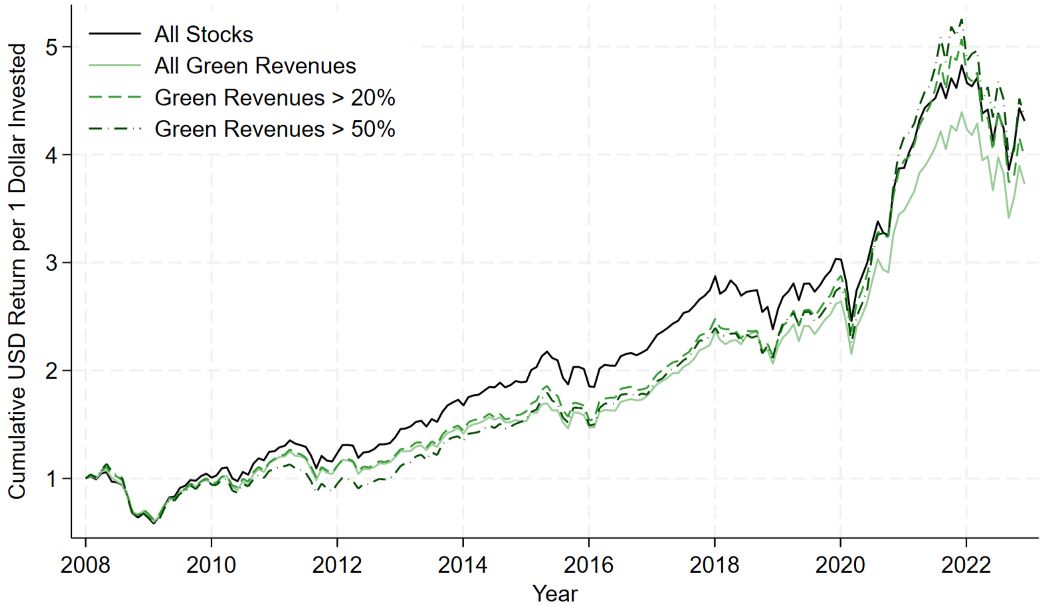
Internet Appendix

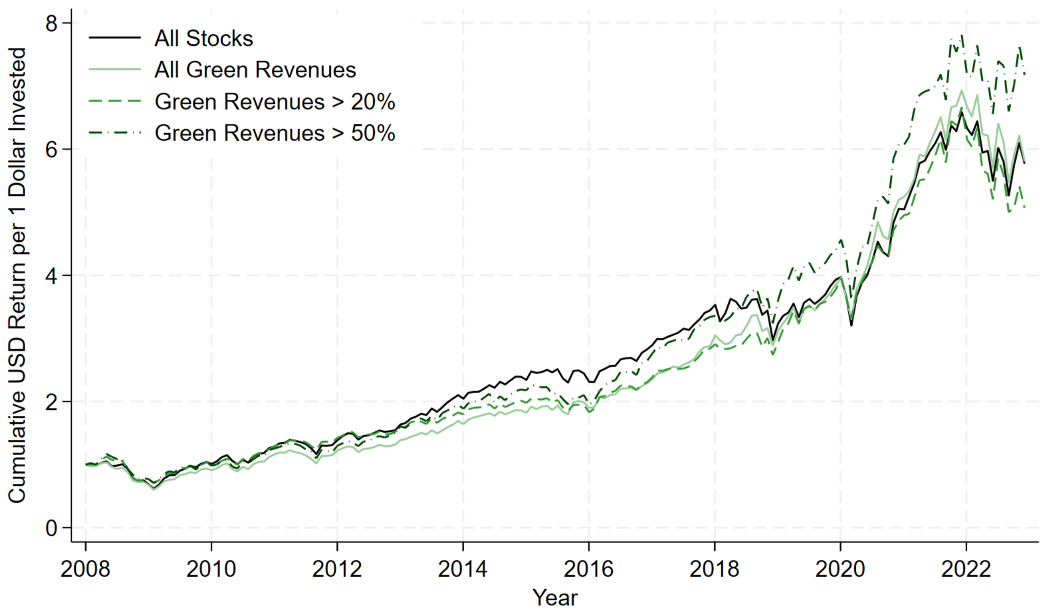
The Green Transition:

Evidence from Corporate Green Revenues

Figures

Figure I.A.1. Green Revenues Global Returns excluding Tesla
In the top graph, we plot cumulative returns per 1 USD invested for the value-weighted green stocks portfolio (light green) and contrast it with portfolios containing stocks with at least 20% (dashed green) and 50% (dashed darker green) green revenues, respectively. The black line plots cumulative returns for the portfolio including all stocks in our sample and serves as a benchmark. Tesla is excluded from all portfolios. In the bottom graph, we plot cumulative returns per 1 USD invested for the value-weighted green stocks portfolio (light green) and contrast it with portfolios containing stocks with at least 20% (dashed green) and 50% (darker green dashed) green revenues, respectively. The black line represents cumulative returns for the portfolio including all stocks in our sample and serves as a benchmark. Tesla is excluded from all portfolios.





Tables

Table I.A.1. Correlation with Other Environmental Measures (GR > 0)
Below the diagonal, this table shows pairwise Pearson correlation coefficients for % company green revenues and various environmental measures that have been used extensively in the finance literature. These include scope 1, 2, and 3 carbon intensities from Trucost and environmental (ESG) scores from MSCI. *E-Score PST* is the modified environmental score proposed in Pastor et al. (2022), and *Ad. ESG Score* is the industry-adjusted ESG score from MSCI. Above the diagonal, the table shows Spearman correlation coefficients. All correlation coefficients are significant at the 1% significance level. The number of pairwise observations is in parentheses. We exclude firms that have no green revenues.

Variables	% Green Revenues	CO2 Int. Scope 1	CO2 Int. Scope 2	CO2 Int. Scope 3	E-Score PST	Ad. ESG Score
% Green Revenues	1.00	0.02	-0.02	-0.11	-0.01	0.07
	(33,511)	(18,555)	(18,555)	(18,555)	(5,911)	(5,911)
CO2 Int. Scope 1	-0.04	1.00	0.34	0.40	-0.62	-0.17
	(18,555)	(18,555)	(18,555)	(18,555)	(4,085)	(4,085)
CO2 Int. Scope 2	0.00	0.06	1.00	0.30	-0.20	-0.06
	(18,555)	(18,555)	(18,555)	(18,555)	(4,085)	(4,085)
CO2 Int. Scope 3	-0.10	0.31	0.10	1.00	-0.47	-0.17
	(18,555)	(18,555)	(18,555)	(18,555)	(4,085)	(4,085)
E-Score PST	-0.00	-0.41	-0.12	-0.44	1.00	0.24
	(5,911)	(4,085)	(4,085)	(4,085)	(39,069)	(39,069)
Ad. ESG Score	0.02	-0.17	-0.04	-0.15	0.30	1.00
	(5,911)	(4,085)	(4,085)	(4,085)	(39,069)	(39,071)

Table I.A.2. Tesla Portfolio Weight

Panel A: Tesla Weight in Global Portfolios (%)				
Year	All Stocks	> 0%	> 20%	> 50%
2010	0.01	0.02	0.09	0.32
2011	0.01	0.03	0.11	0.40
2012	0.01	0.03	0.14	0.50
2013	0.03	0.15	0.59	1.89
2014	0.05	0.19	0.82	2.56
2015	0.05	0.22	0.91	2.60
2016	0.06	0.19	0.73	1.80
2017	0.08	0.25	0.93	2.18
2018	0.08	0.27	1.06	2.66
2019	0.10	0.32	1.04	2.89
2020	0.87	2.48	7.24	16.33
2021	1.11	3.05	8.48	19.79
2022	0.48	1.33	3.71	10.13

Panel B: Tesla Weight in US Portfolios (%)				
Year	All Stocks	> 0%	> 20%	> 50%
2010	0.02	0.08	0.33	1.47
2011	0.02	0.09	0.36	1.77
2012	0.02	0.10	0.42	2.02
2013	0.09	0.40	1.77	7.74
2014	0.12	0.49	2.40	8.65
2015	0.14	0.54	2.86	10.86
2016	0.14	0.44	2.00	5.46
2017	0.19	0.58	2.62	7.65
2018	0.20	0.59	2.91	8.56
2019	0.24	0.67	2.24	8.85
2020	1.89	4.72	13.98	41.58
2021	2.35	5.66	16.47	48.56
2022	1.01	2.47	6.92	29.30

Table I.A.3. The Role of Regulatory Push (Lagged)

In this table, we estimate the effect of increased green regulation on firm *Green Revenues %*. We split the sample into firms incorporated in *Europe*, where a strong regulatory push occurred after the Paris Agreement, and the rest of the sample comprising countries with less green regulation. *Post Paris* is a dummy equal to 1 if the year ≥ 2016. *Post TEG* is equal to 1 if the year ≥ 2018, where *TEG* indicates the creation of the Technical Expert Group commissioned to create the EU green taxonomy. *Post EUTSF* is equal to 1 if the year ≥ 2020, where *EUTSF* stands for the EU Taxonomy on Sustainable Finance rolled out in 2020. Control variables are lagged by one year. By *, **, and ***, we denote p-levels below 10%, 5%, and 1%, respectively. Standard errors clustered on the country level are in parentheses.

Regression	(1)	(2)	(3)	(4)
Variables	Green Revenues % t+1			
Europe	0.973**	1.092**	1.269***	0.972**
	(0.400)	(0.410)	(0.431)	(0.400)
Europe x Post Paris	1.129**			0.491
	(0.456)			(0.349)
Europe x Post TEG		1.274***		0.534***
		(0.436)		(0.153)
Europe x Post EUTSF			1.359***	0.630**
			(0.479)	(0.266)
L. ln(Sales)	0.994***	0.993***	0.993***	0.993***
	(0.128)	(0.127)	(0.127)	(0.127)
L. Tobin's Q	0.172***	0.169***	0.170***	0.169***
	(0.0430)	(0.0437)	(0.0434)	(0.0435)
L. Leverage	-0.256	-0.262	-0.271	-0.267
	(0.465)	(0.465)	(0.464)	(0.463)
L. ROA	-5.824***	-5.798***	-5.785***	-5.802***
	(1.492)	(1.492)	(1.487)	(1.490)
L. Cash	-1.041	-1.036	-1.042	-1.042
	(0.692)	(0.695)	(0.696)	(0.692)
L. Capex	9.043***	9.065***	9.095***	9.049***
	(2.484)	(2.485)	(2.478)	(2.488)
L. R&D	2.878	2.911	2.928	2.913
	(3.930)	(3.925)	(3.929)	(3.921)
Constant	-1.972	-1.965	-1.969	-1.964
	(1.339)	(1.333)	(1.336)	(1.334)
Observations	190,356	190,356	190,356	190,356
R-squared	0.068	0.068	0.068	0.068
Sector Fixed Effect	YES	YES	YES	YES
Year Fixed Effect	YES	YES	YES	YES
Country Cluster	YES	YES	YES	YES

Table I.A.4. The Role of Green Innovation (Lagged)

This analysis aims to explore the heterogeneity in green corporate innovation before the Paris Agreement and how it impacts green revenues generated through the sales of green products and services. We test whether corporate green innovation measured by the variable *GP Indicator*, which is equal to one if a company had at least one green patent between 2008 and 2013, impacts the sales of green products and services captured by the variable *Green Revenues %*. Alternatively, *GP Ratio* measures average annual green patents relative to all patents created by a company between 2008 and 2013. *Post Paris* is a dummy equal to 1 if the year $\geq$ 2016. We interact *GP Ratio/Indicator* with *Post Paris* to explore how firms with heterogenous levels of green innovation are differently prepared for a green transition after the Paris Agreement. Control variables are lagged by one year. By *, **, and ***, we denote p-levels below 10%, 5%, and 1%, respectively. Standard errors clustered on the country level (except in column (3)) are in parentheses.

Regressions	(1)	(2)	(3)	(4)	(5)
Variables	Green Revenues % t+1				
GP Indicator	6.160**				
	(2.425)				
GP Indicator x Post Paris	2.812***				
	(0.329)				
GP Ratio		42.59***	61.04***	33.00**	5.720
		(11.57)	(1.984)	(14.22)	(5.107)
GP Ratio x Post Paris		16.39***	16.74***	4.632	0.716
		(2.140)	(2.799)	(6.561)	(8.586)
Observations	190,356	190,356	31,949	31,068	5,897
R-squared	0.073	0.081	0.132	0.093	0.043
Sample	GLOBAL	GLOBAL	USA	EUROPE	ENERGY
Sector Fixed Effect	YES	YES	YES	YES	NO
Year Fixed Effect	YES	YES	YES	YES	YES
Country Cluster	YES	YES	NO	YES	YES

Table I.A.5. The Role of Institutional Investors (Lagged)

In this table, we explore the role of institutional shareholders in the green transition. The dependent variable is *Green Revenues %* and the main explanatory variables are the total share of institutional ownership (*IO*), the share of responsible institutional ownership (*IO PRI*) and climate-focused institutional ownership (*IO CDP*) in the year 2015, which we keep constant over the sample period in our main regression setup to explore how institutional ownership pre-Paris influenced firm green revenues post Paris. *Post Paris* is a dummy equal to 1 if the year $\geq$ 2016. Institutional ownership is considered green when institutional investors are signatories of the Principles of Responsible Investing (*IO PRI*) and climate-related when the institutional owner is part of the Carbon Disclosure Project (*IO CDP*). *IO Turnover* measures the holdings-weighted Churn ratio of institutional owners by firm. Control variables are lagged by one year. By *, **, and ***, we denote p-levels below 10%, 5%, and 1%, respectively. Standard errors clustered on the country level are in parentheses.

Regression	(1)	(2)	(3)	(4)
Variables		Green Revenues % t+1		
IO	2.154***			
	(0.271)			
IO x Post Paris	2.152***			
	(0.626)			
IO PRI		8.454***		
		(0.647)		
IO PRI x Post Paris		1.529		
		(1.287)		
IO CDP			8.056***	
			(0.820)	
IO CDP x Post Paris			5.386***	
			(1.784)	
Turnover				-1.472
				(1.991)
Turnover x Post Paris				-2.119*
				(1.235)
Observations	175,660	175,660	175,660	162,427
R-squared	0.071	0.073	0.073	0.072
Controls	YES	YES	YES	YES
Sector Fixed Effect	YES	YES	YES	YES
Year Fixed Effect	YES	YES	YES	YES
Country Cluster	YES	YES	YES	YES

Table I.A.6. The Role of Regulatory Push (USD)

In this table, we estimate the effect of increased green regulation on firm *Green Revenues US Dollars*. We split the sample into firms incorporated in *Europe*, where a strong regulatory push occurred after the Paris Agreement, and the rest of the sample comprised of countries with less green regulation. *Post Paris* is a dummy equal to 1 if the year is $\geq$ 2016. *Post TEG* is equal to 1 if the year is $\geq$ 2018, where *TEG* indicates the creation of the Technical Expert Group commissioned to create the EU green taxonomy. *Post EUTSF* is equal to 1 if the year is $\geq$ 2020, where *EUTSF* stands for the EU Taxonomy on Sustainable Finance rolled out in 2020. By *, **, and ***, we denote p-levels below 10%, 5%, and 1%, respectively. Standard errors clustered on the country level are in parentheses.

Regression	(1)	(2)	(3)	(4)
Variables	Green Revenues US Dollars			
Europe	13,587**	13,471***	13,973***	13,585**
	(5,063)	(4,635)	(4,517)	(5,063)
Europe x Post Paris	3,274			-523.6
	(2,702)			(2,412)
Europe x Post TEG		5,032*		3,317**
		(2,742)		(1,456)
Europe x Post EUTSF			6,025*	3,620**
			(3,012)	(1,650)
Observations	224,571	224,571	224,571	224,571
R-squared	0.086	0.086	0.086	0.086
Controls	YES	YES	YES	YES
Sector Fixed Effect	YES	YES	YES	YES
Year Fixed Effect	YES	YES	YES	YES
Country Cluster	YES	YES	YES	YES

Table I.A.7. The Role of Green Innovation (USD)

This analysis aims to explore the heterogeneity in green corporate innovation before the Paris Agreement and how it impacts green revenues generated through the sales of green products and services. We test whether corporate green innovation measured by the variable *GP Indicator*, which is equal to one if a company had at least one green patent between 2008 and 2013, impacts the US Dollar sales of green products and services captured by the variable *Green Revenues US Dollars*. Alternatively, *GP Ratio* measures average annual green patents relative to all patents created by a company between 2008 and 2013. *Post Paris* is a dummy equal to 1 if the year $\geq$ 2016. We interact *GP Ratio/Indicator* with *Post Paris* to explore how firms with heterogenous levels of green innovation are differently prepared for a green transition after the Paris Agreement. By *, **, and ***, we denote p-levels below 10%, 5%, and 1%, respectively. Standard errors clustered on the country level (except in column (3)) are in parentheses.

Regressions	(1)	(2)	(3)	(4)	(5)
Variables			Green Revenues US Dollars		
GP Ratio		300,095***	182,484***	851,987***	291,022
		(90,382)	(11,091)	(193,848)	(224,041)
GP Ratio x Post Paris		243,173***	262,732***	81,425	-121,901
		(37,376)	(16,363)	(172,667)	(247,115)
GP Indicator	63,176***				
	(15,051)				
GP Indicator x Post Paris	63,250***				
	(10,976)				
ln(Sales)	12,000***	12,924***	12,346***	18,213***	4,936***
	(1,563)	(1,575)	(321.3)	(5,264)	(1,718)
Tobin's Q	2,517***	2,528***	3,164***	2,107	1,283**
	(495.4)	(490.8)	(269.9)	(1,361)	(549.4)
Leverage	-13,762**	-14,305***	-3,973	-33,595***	-11,357
	(5,132)	(4,896)	(2,530)	(6,382)	(7,587)
ROA	-60,973***	-57,598***	-51,971***	-104,61***	2,271
	(11,721)	(11,088)	(4,987)	(31,790)	(26,373)
Cash	1,483	1,672	11,862***	6,537	3,995
	(3,085)	(3,495)	(3,672)	(7,306)	(6,362)
Capex	8,693	9,808	56,905***	-77,088	2,881
	(13,089)	(13,416)	(11,664)	(58,377)	(10,327)
R&D	-51,948***	-22,050	-26,864**	-25,451	106,277
	(15,146)	(13,894)	(12,555)	(33,537)	(137,844)
Constant	-59,079***	-64,763***	-60,788***	-80,755*	-27,208**
	(11,129)	(11,139)	(4,101)	(41,597)	(10,426)
Observations	224,571	224,571	38,064	36,783	7,085
R-squared	0.107	0.106	0.111	0.166	0.058
Sample	GLOBAL	GLOBAL	USA	EUROPE	ENERGY
Sector Fixed Effect	YES	YES	YES	YES	NO
Year Fixed Effect	YES	YES	YES	YES	YES
Country Cluster	YES	YES	NO	YES	YES

Table I.A.8. The Role of Institutional Investors (USD)

In this table, we explore the role of institutional shareholders in the green transition. The dependent variable is *Green Revenues US Dollars* and the main explanatory variables are the total share of institutional ownership (*IO*), the share of responsible institutional ownership (*IO PRI*) and climate-focused institutional ownership (*IO CDP*) in the year 2015, which we keep constant over the sample period in our main regression setup to explore how institutional ownership pre-Paris influenced firm green revenues post Paris. *Post Paris* is a dummy equal to 1 if the year $\geq$ 2016. Institutional ownership is considered green when institutional investors are signatories of the Principles of Responsible Investing (*IO PRI*) and climate-related when the institutional owner is part of the Carbon Disclosure Project (*IO CDP*). *IO Turnover* measures the holdings-weighted Churn ratio of institutional owners by firm. By *, **, and ***, we denote p-levels below 10%, 5%, and 1%, respectively. Standard errors clustered on the country level are in parentheses.

Regression	(1)	(2)	(3)	(4)
Variables	Green Revenues US Dollars			
IO	-9,907**			
	(4,502)			
IO x Post Paris	16,472***			
	(3,267)			
IO PRI		-3,612		
		(16,493)		
IO PRI x Post Paris		35,443***		
		(4,771)		
IO CDP			-8,191	
			(18,697)	
IO CDP x Post Paris			57,675***	
			(6,165)	
Turnover				-4,592
				(5,327)
Turnover x Post Paris				-16,075***
				(3,169)
tObservations	204,130	204,130	204,130	192,169
R-squared	0.089	0.089	0.090	0.092
Controls	YES	YES	YES	YES
Sector Fixed Effect	YES	YES	YES	YES
Year Fixed Effect	YES	YES	YES	YES
Country Cluster	YES	YES	YES	YES

Table I.A.9. Green Revenues Portfolios: Robustness

In this table, we aim to examine how different shades of green are valued by the market and whether different tierings based on the level of "greenness" result in a green *Alpha*. We further split the sample into two periods. *Pre Paris* includes all years from 2008 to 2015, and *Post Paris* considers the time period from 2016 to 2022. We calculate monthly portfolio returns and regress them on the 5-factor model as proposed in Table 6, column 5. The first green portfolio includes all stocks with *Green Revenues* > 0% (column 1), the second portfolio includes stocks with *Green Revenues* > 20% (column 2), the third portfolio considers stocks with *Green Revenues* > 50% (column 3), and the fourth portfolio considers stocks with *Green Revenues* > 80% in the first year the firm appears in the sample (column 4). We also refer to stocks with *Green Revenues* > 80% as "pure plays". Panel A shows value-weighted portfolio returns for the global sample, excluding Tesla. Panel B shows value-weighted portfolio returns for the US sample, excluding Tesla. Panel C considers equally-weighted global portfolio returns. Lastly, Panel D considers equally-weighted portfolio returns for US firms. By *, **, and ***, we denote p-levels below 10%, 5%, and 1%, respectively. Standard errors are in parentheses.

Regression	(1)	(2)	(3)	(4)
Variable	Green Revenues %			
Portfolio	> 0%	> 20%	> 50%	> 80%
Panel A: All Firms without Tesla Value-Weighted				
Alpha	-0.124	-0.0821	-0.0193	0.212
	(0.0807)	(0.0975)	(0.133)	(0.200)
Alpha (Pre Paris)	-0.278***	-0.258**	-0.264	-0.164
	(0.0953)	(0.119)	(0.167)	(0.232)
Alpha (Post Paris)	0.0565	0.123	0.266	0.652**
	(0.114)	(0.138)	(0.184)	(0.267)
Panel B: US Firms without Tesla Value-Weighted				
Alpha	-0.0041	-0.0129	0.200	0.549**
	(0.130)	(0.146)	(0.203)	(0.229)
Alpha (Pre Paris)	-0.222*	-0.252	-0.127	0.083
	(0.132)	(0.180)	(0.267)	(0.282)
Alpha (Post Paris)	0.249	0.265	0.580**	1.092***
	(0.206)	(0.206)	(0.265)	(0.312)
Panel C: All Firms Equally-Weighted				
Alpha	-0.134*	-0.0707	-0.0423	0.071
	(0.0704)	(0.0848)	(0.119)	(0.159)
Alpha (Pre Paris)	-0.190*	-0.154	-0.244	-0.297
	(0.106)	(0.120)	(0.168)	(0.219)
Alpha (Post Paris)	-0.0705	0.0243	0.188	0.490**
	(0.0801)	(0.107)	(0.147)	(0.195)
Panel D: US Firms Equally-Weighted				
Alpha	-0.126	0.0002	0.309*	0.499**
	(0.0917)	(0.111)	(0.159)	(0.208)
Alpha (Pre Paris)	-0.226*	-0.144	0.001	-0.024
	(0.130)	(0.151)	(0.218)	(0.270)
Alpha (Post Paris)	-0.00925	0.168	0.667***	1.107***
	(0.109)	(0.148)	(0.217)	(0.300)