Climate Policy and Sustainable Investments around the World

by

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Climate Policy and Sustainable Investments around the World[§]

Huanhuan Zheng[1]

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Abstract: We explore the worldwide investment impacts of climate policies, using a difference-in-differences approach that compares sustainable and traditional investments within the same economy after the establishment of a climate policy relative to pre-policy levels. We find that climate policy accelerates the growth of sustainable investments and improves their returns, which is driven by the nonpecuniary channel of climate mitigation and adaption but not the pecuniary channel of risk-return optimization. Moreover, the impact of climate policy is more pronounced in economies with tighter carbon regulations and greater penetration of sustainable investments, especially those from foreign, institutional, and passive investors.

Keywords: sustainable growth, ESG, SRI, climate policy, carbon emission
JEL: E62, E65, F34, F21

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1. Introduction

With growing climate activism, more and more governments worldwide have pledged to achieve net-zero emissions by mid-century. Some governments have rolled out climate policies such as the Emission Trading System (ETS) and carbon tax to regulate carbon emissions. The effectiveness of climate policy on reducing emissions, promoting clean production and green innovation, and improving social welfare has received growing research interest.[2] However, the potential of climate policy to attract private investment to underpin climate mitigation and adaption is rarely studied. Relying on public resources to finance large-scale green infrastructure and research and development (R&D) is important but not sufficient. To close the investment gaps necessary for the transition to net zero, governments need to adopt policies to leverage private investments (Gates, 2021).

The objective of this paper is to study whether and how climate policies attract international sustainable investments,[3] which pursue social mandates such as mitigating climate change on top of financial returns. Sustainable investments consider factors such as environmental, social, and governance (ESG), and corporate social responsibility (CSR), in their search for financial returns. They seek to support climate-friendly activities such as R&D of clean energy, carbon capture, and storage technologies through preferential treatment of green assets that finance these activities. To pursue these social mandates, they are willing to accept lower investment returns and longer investment horizons for green assets (see, for example, Baker et al., 2018; Pástor et al., 2021). Sustainable investments favour not just green assets in investors' home countries but also those in international markets. The worldwide asset under management (AUM) targeting sustainable investments grew from $11 million in 2001 to $2 trillion in 2021—an 83% compound annual growth rate—according to EPFR Global, the data provider. Riding such a strong upward trend could potentially scale up climate investments to make a difference to zero-carbon products and technologies.

Climate policy could potentially attract international sustainable investments from two channels. First, climate policy backs sustainable investments' pursuits of climate mitigation

[2] See, for example, Avci et al. (2015), Bayer & Aklin (2020), Calel & Dechezleprêtre (2016), Cameron et al. (2016), and Cui et al. (2018), among many others.
[3] Sustainable investments are also referred to as socially responsible investments (SRI), environment, social, and corporate governance (ESG) investments, impact investments, and responsible investments, among other terms.

and adaption. Sustainable investments seek to promote carbon-friendly activities through preferential treatment of the green assets that finance these projects. Climate policy delivers what sustainable investments aim to achieve—it effectively reduces carbon emissions (Bayer & Aklin, 2020), sparks green innovations (Cui et al., 2018) and promotes the consumption and generation of clean energy (Lin & Jia, 2020), among many other benefits, all of which contribute to climate mitigation and adaption. Moreover, as public and private climate actions are complementary (Sachs et al., 2019), sustainable investments are expected to generate greater social impact with the support of climate policy.

Second, climate policy magnifies the climate-related opportunities for sustainable investment that could potentially improve the returns and/or reduce the risks of such investment. By putting a price on carbon emissions, climate policy unleashes the power of markets to quickly and efficiently reallocate resources to climate-friendly activities such as clean production and green innovation. To reduce emission costs, regulated firms increase their demand for green technology and clean production. This improves the valuations of the green assets that finance these green projects (Huynh and Xia, 2021; Pastor et al., 2021), while reducing their exposure to climate regulatory risks (Ilhan et al., 2021; Seltzer et al., 2020). As a result, sustainable investments holding these green assets may have higher financial returns and/or lower financial risks after the introduction of climate policy. The substantial public and private resources mobilized by climate policy also increase the probability of a big breakthrough in carbon technology, which requires extremely expensive and time-consuming R&D and bears a high risk of failure but yields huge profits once successful. Anticipation of substantial eventual profit may motivate pecuniary investors to scale up sustainable investments.

Climate policy creates new business opportunities for green technologies and products, as firms seek to comply with carbon regulations and improve their greenness to save emission costs. This improves the valuation of the green assets that finance these green projects and increases the financial returns from sustainable investments that hold these green assets. The rising financial returns may increase the demand for green assets among existing sustainable investors while also attracting newcomers. Rising demand further boosts green asset valuation, which increases the returns to sustainable investments. Climate policy may also reduce financial risks by mitigating the likelihood of "greenwashing": the practice of allegedly misstating or exaggerating greenness in order to access green finance. By forcing firms to pay for their emissions, climate policy motivates firms to turn green funding into emission-reduction activities instead of greenwashing so as to save emission costs. As a result, the risk of green asset valuation collapsing because of greenwashing is lower in the presence of climate policy.

While climate policy may attract sustainable investment by mitigating climate change and enriching climate-related opportunities, it does not seem to have a similar appeal for traditional investments, which seek financial returns. The differential impacts of climate policy on sustainable and traditional investments and the staggered introduction of climate policy worldwide both facilitate the causal identification. We evaluate the impact of climate policy on international sustainable investments using a staggered differences-in-difference (DID) approach, which compares sustainable investments (treatment group) and traditional investments (control group) in the same economy after the announcement of climate policy (post-policy periods) relative to that before the climate policy (pre-policy periods).

Based on a sample that covers weekly sustainable and traditional investments in 94 distinct economies over the period from July 2001 to December 2021, our DID analysis shows that climate policy fosters sustainable investment. In particular, we find that the annual growth difference between sustainable and traditional AUM after the climate policy is about 30% more than its pre-policy level, which provides evidence that climate policy accelerates the growth of sustainable AUM. We further decompose the growth of AUM into capital flows, the new money flowing into an economy as a ratio of existing AUM, and investment returns, the returns generated by existing AUM. Our analysis reveals that both sustainable capital flows and investment returns increase in response to climate policy. This suggests that the faster growth of sustainable AUM after the introduction of climate policies is driven by booming sustainable capital flows and improved sustainable investment returns. Further looking into the risk aspects of sustainable investment, we find that climate policy reduces the volatility in the growth of sustainable AUM as well as its two components—capital flows and investment returns. This mitigates the potential concern that climate policy might improve sustainable investment returns because it increases their risk exposures.

After establishing the positive impact of climate policy on sustainable investment, we proceed to explore the underlying mechanisms. Climate policy may attract sustainable investment by improving financial risk-return trade-offs (pecuniary channel) or mitigating climate change (nonpecuniary channel). It is empirically challenging to test these two channels separately, given that climate policy contributes to climate mitigation, return improvements, and risk reductions. However, the staggered adoption of climate policy worldwide creates substantial variations in its financial and social impact across different economies and over time, which allows us to perform these tests.

The pecuniary channel implies that investors are doing good (supporting climate mitigation and adaptation through sustainable investment) in order to do well (achieving strong financial performance), as they expect sustainable investments to maximize long-term intertemporal profits (Benabou & Tirole, 2010). If climate policy attracts sustainable investment through the pecuniary channel, economies that benefit more from climate policy in improving risk-return trade-offs should attract disproportionately more sustainable investment after the introduction of climate policy. To test this hypothesis, we first calculate the climate policy-related return improvements (risk reduction) as the difference in sustainable investment returns (return volatility) between post- and pre-policy periods. We then estimate the differential impacts of climate policies with relatively high and low return improvements (risk reductions), using the sample median as a cut-off. We find no statistical evidence that sustainable capital flows respond more positively to climate policies that contribute more to either return improvements or risk reductions, which lends no support to the pecuniary channel. We further show that despite significant return improvements (risk reductions) after climate policy, sustainable investments returns (risks) remain lower (higher) than traditional investment returns (risks), though the difference is no longer statistically significant as in the pre-policy periods. This further mitigates the possibility of a pecuniary channel—the premise that if sustainable investors were to prioritize their financial mandates, they could be better off switching to traditional investments.

The nonpecuniary channel builds upon Pástor et al (2021), who show that investors drive utility by holding green assets that finance climate-friendly activities and are therefore willing to pay higher prices or accept lower expected returns for green assets. If the nonpecuniary channel is driving our result, climate policy that contributes more to forms of climate mitigation and adaptation that align with sustainable investors' social mandates should attract more sustainable investment. We first calculate climate policy-related carbon emission reductions, renewable energy generation, and green technology innovations as the difference in these measures of climate mitigation and adaptation between post- and pre-policy periods and then normalize it by its pre-policy average. Based on the median value of this measure, we then split the sample into two subgroups and evaluate the differential impacts of climate policy. We find evidence that climate policies associated with higher carbon emission reductions, renewable energy generation, or green technology innovations attract significantly more sustainable investment, which supports the nonpecuniary channel.

To mitigate potential concerns over confounding factors, we control for (asset) class-time economy-time fixed effects throughout our analysis. We further perform a series of robustness checks to verify the impact of climate policy on sustainable investment. We show that the difference between sustainable and traditional investments before the introduction of a climate policy is relatively stable and not statistically significant but escalates and becomes statistically significant after the climate policy is initiated. This alleviates the possibility that other factors are driving our results—otherwise they should have attracted sustainable investment even in the absence of climate policy. Our finding that climate policy accelerates the growth of sustainable AUM continues to hold when we control for additional variables and employ alternative model specifications and samples.

Finally, we conduct various heterogeneity analyses to better understand the role of climate policy and its interaction with different types of sustainable investment. We focus on the announcement of climate policy to capture investors' potential forward-looking behaviour in our main analysis. Differentiating the announcement and implementation effects in the post-policy periods, we find that sustainable investment grows even faster after the implementation of climate policy, which suggests an underestimate of climate policies' financial impacts before their implementation. We also show that sustainable investments are more responsive to climate policy when implemented at national rather than sub-national level, when both ETS and carbon tax are in place, and when carbon prices are higher. Looking into the structure of sustainable investments by market and investor characteristics, we find that the impact of climate policy is more pronounced for sustainable investments that are larger in scale or more dominated by foreign, institutional, ETF, or passive investors.

Our findings have important policy implications. First, the causal impact of climate policy on international sustainable investment uncovers the co-benefits of climate policy—the efforts dedicated to climate change adaptation and mitigation also yield financial benefits. Given the importance of sustainable investment in offering long-term and low-cost green capital, countries—especially those relying on international capital for economic growth or pledged transition to net zero—may be more motivated to adopt climate policies if they realize that the financial benefits of doing so are larger than previously thought. Second, climate policy attracts sustainable investment by enhancing climate mitigation and adaptation, which demonstrates that effective climate actions carry rewards. This calls for innovative design and consistent implementation of climate policy to improve its effectiveness in reducing carbon emissions, encouraging renewable energy generation and green technology innovations, which could enhance a country's attractiveness to international sustainable investors. It also mitigates concerns over greenwashing as sustainable investments are found to be more responsive to their social mandates than their financial mandates. Third, climate policy could better boost sustainable investments that have reached a certain scale. To better leverage climate policy to promote sustainable investment, public support for fostering sustainable investment at the early stage would be valuable.

Related literature

This paper contributes to three strands of literature. First, it adds to the burgeoning literature on sustainable investment by exploring its determinants in an international context. Existing studies show that sustainable investments, also referred to as socially responsible investments or ESG investments, tolerate lower returns for holding green assets as they derive nonpecuniary utility from financing climate-friendly activities (Barber et al., 2021; Oehmke & Opp, 2019; Pástor et al., 2021a). As a result, the booming sustainable investments reduce green financing costs (Baker et al., 2018; Chava, 2014; Zerbib, 2019) and increase the risk premium required for carbon and climate risk exposure (Andersson et al., 2016; Bolton & Kacperczyk, 2021; Hong & Kacperczyk, 2009; Ilhan et al., 2021). These studies focus on the financial consequences of sustainable investment, which advances our understanding of how such investments price in climate risks through preferential treatment of green assets. We complement this strand of literature by documenting international evidence on the drivers of sustainable investment. Our finding that domestic climate policy attracts international sustainable investments points to a new tool to finance climate mitigation and adaptation worldwide. Knowing where and how to obtain sustainable investments is especially important when governments cannot afford the level of climate investment necessary to transition to net zero due to rising fiscal deficits or falling tax revenues.

Second, our study builds upon the research exploring the financial impacts of climate regulations to uncover new channels through which climate policy promotes sustainable investment. Krueger et al. (2020) provide survey evidence that investors incorporate climate risk in their investment decisions, and they rank regulatory risk on top of physical and technological risk. Seltzer et al. (2020) find that climate regulatory risks reduce credit ratings and increase liquidity risks for firms with poorer environmental performance or higher carbon footprints. Engle et al., (2020), Huynh & Xia (2021), and Ilhan et al. (2021) document a similar negative impact of climate regulatory risk on asset pricing in equity, bond, and option markets. Investors thus require higher expected returns to compensate for the risk exposure caused by climate policy uncertainty (Hsu et al., 2022; Pastor et al., 2021). Consistent with these studies, we find that climate policy, which explicitly imposes costs on carbon emissions, improves the returns while reducing the risks relating to sustainable investments that prioritize green assets. However, we find that such financial gains are not the reason why sustainable investments increase in response to climate policy. Utilizing the impact variations across economies and over time elicited by the staggered adoption of climate policy worldwide, we contribute to the literature by documenting evidence that climate policy that contributes more to climate mitigation and adaptation attracts more sustainable investment, which supports the nonpecuniary incentives of sustainable investing highlighted in Pástor et al. (2021b).

Third, our work adds new evidence of the financial impacts of climate policy. Studies have shown that climate policy reduces carbon emissions (Bayer & Aklin, 2020), increases adoption and generation of clean energy (Avci et al., 2015; Cameron et al., 2016), encourages green innovation (Calel & Dechezleprêtre, 2016; Cui et al., 2018; Fried et al., 2018) and improves human well-being (Creutzig et al., 2021). While these studies focus on the social and scientific aspects of climate policy, we document its causal impact on increasing international sustainable investment, which is vital to accelerating the transition to low carbon economies.

The remainder of this paper is organized as follows. Section 2 describes the data and explains the methodology, Section 3 discusses the empirical results and explores the economic mechanisms underlying the impact of climate policy on sustainable investment, Section 4 presents additional heterogeneity analysis and robustness checks, and Section 5 concludes.

2. Data and Methodology

2.1. Data

2.1.1. International sustainable investments

We obtain weekly international sustainable investments from Emerging Portfolio Fund Research (EPFR). EPFR tracks the international asset allocation of mutual funds that integrate socially responsible investing (SRI) and ESG into their investment process. To have the SRI and ESG labels, funds' investments have to undergo a review of ESG quality, SRI, or green practices. Unlike traditional investors that focus exclusively on financial gains, these sustainable investors also emphasize or even prioritize social welfare and sustainable development in their investment decisions. EPFR records the total AUM, capital flows, and investment returns to each economy from sustainable investors worldwide. According to the asset classes of investments, EPFR records sustainable investments in equity and bond markets separately. Moreover, depending on the domiciles, size, and investment strategies of these investors, EPFR further subdivides sustainable investments from foreign and domestic, small and large, as well as passive and active investors.

EPFR also records similar data for traditional investments that seek financial returns. To improve comparability between sustainable and traditional investments across economies and different asset classes, we normalize (i) the change in total AUM, (ii) total capital flows, and (iii) the overall investment profits, by the previous week's total AUM of either sustainable or traditional investments in a specific asset class (equity or bond) in a particular economy. These normalized variables are our key dependent variables in empirical analysis. We denote them as *AUM growth*, *Flow*, and *Return*, which represent the growth in AUM, intensity of new capital flows, and investment returns, respectively. In the absence of cash holding, we have *AUM growth* = *Flow* + *Return*, which allows us to explore whether the growth in AUM is driven by new money or returns on existing investments.

Our sample spans from July 27, 2001, when EPFR started to report economy-level sustainable investments, to December 2021. We require an economy to have at least 5-year (260-week) track records on both types of investments (sustainable and traditional) in either equity or bond markets to be included in our sample. Our final sample covers weekly sustainable and traditional investments in 94 distinct economies over 1,106 weeks.

2.1.2. Climate policy

Data on national, subnational, and regional carbon pricing initiatives including ETS and carbon tax are from the World Bank (WB).[4] WB records the implementation date, the coverage of regulated carbon emissions as a ratio of total emissions, and the carbon price and/or carbon tax of existing, operational climate policies. For climate policies that have been implemented, we look into official documents and news releases to manually track their announcement dates, when governments formally confirmed to the public their intention to work towards implementing ETS or carbon tax. Knowing the announcement dates enables us to analyze the forward-looking behaviour of sustainable investments in response to anticipated climate policy even before its actual implementation. Other than implemented climate policy, WB also reports carbon pricing initiatives that are currently under consideration and have been endorsed by official government resources or scheduled for implementation, and which have been formally adopted through legislation. We consider both the announcement and the implementation of climate policy in order to develop a broad picture of how sustainable investments respond to climate policy at different stages of adoption.

Out of the 94 economies in our sample, 49 (52%) have officially announced their intention to adopt some sort of climate policy, and 41 have gone on to implement such a policy. As of December 2021, 20 economies have committed to both ETS and carbon tax, four economies have committed only to carbon tax, and 25 have committed only to ETS. Most climate policies have been scaled up to national level by 2021. Only two out of the 45 economies that opted for ETS—the US and Japan, and one out of the 27 economies that opted for carbon tax—Mexico, implemented these policies only at sub-national level. *Appendix Table 1* provides a list of economies with different types of climate policies.

[4] https://carbonpricingdashboard.worldbank.org/map_data

2.1.3. Climate mitigation and adaption measures

We measure the extent of climate mitigation and adaptation by the reduction in carbon emissions and increase in renewable generation and green innovations related to climate policy.

Carbon emissions

Global warming could increase the severity and frequency of extreme weather events (such as heatwaves and floods) and accelerate sea level rises, which expose economic activities to physical damage. The Paris Agreement advises nations to cut carbon emissions to limit the global temperature increase to 1.5 °C relative to pre-industrial levels by mid-century. Climate policy is effective in reducing carbon emissions (Bayer & Aklin, 2020), which slows down the pace of global warming. To compare climate-policy-related reductions in carbon emissions across economies, we calculate the difference in carbon emissions per capita between post- and pre-policy periods, normalized by their pre-policy levels. Annual data on carbon emissions per capita are from the World Bank's World Development Index (WDI).

Renewable energy generation

Renewable energy has a much lower carbon footprint than fossil fuels, but its supply falls short of the demand due to higher costs, lack of economy scale, and the technological bottleneck in energy storage, among other factors. Increasing renewable generation capacity is the necessary condition to gradually replace fossil fuels with renewable energy and thereby mitigate climate change. We obtain data on renewable energy generation from BP's Statistical Review of World Energy 2021 and calculate its improvements related to climate policy. In particular, we take the difference in renewable energy generation between post- and pre-policy periods and normalize it by the pre-policy renewable energy generation.

Green technology innovations

Green technology advances such as a breakthrough in carbon capture and storage could significantly promote adoption of low-carbon technologies. Carbon technology enables large-scale clean production, which leads to climate mitigation and adaptation. We measure the extent of green technology by the number of green patents from Perruchas et al. (2020). To capture climate-policy-related increases in green technology, we take the difference in green patents between post- and pre-policy periods and normalize it by the pre-policy level.

Indicators of climate mitigation and adaptation

To understand whether climate policy that contributes to climate mitigation and adaptation attracts more sustainable investments, we define dummy variables $D_{i,t}^{Carbon}$, $D_{i,t}^{Renewable}$, and $D_{i,t}^{Technology}$ as 1 if economy i's reductions in carbon emissions, improvements in renewable energy generation, and growth in green technology innovations associated with climate policy are above the sample median, respectively, and 0 otherwise.

2.2. Summary statistics

2.2.1. The global trends of sustainable and traditional investment

Figure 1 illustrates the trends of sustainable and traditional investment worldwide. Traditional AUM expanded from $0.23 trillion in 2001 to $24 trillion in 2021, with a compound annual growth rate of 26% over the past two decades. During the same period, sustainable AUM increased from only $11 million to almost $2 trillion, resulting in an 83% compound annual growth rate, which is more than triple the growth of traditional AUM. Although sustainable AUM was much smaller than traditional AUM in scale, the gap between the two shrank over time, thanks to its faster growth. By the end of 2021, the market share of sustainable AUM out of total AUM has reached 8%, up from 5% in 2001.

2.2.2. The global distribution of sustainable investment

Panel A of Figure 2 illustrates the dollar amount of sustainable AUM in each economy by the end of 2021, with a darker colour corresponding to greater size. We observe greater sustainable AUM in larger economies. To compare the relative importance of sustainable investment across economies, Panel B of Figure 2 demonstrates the market share of sustainable AUM in the overall asset management market in 2021, with darker colours corresponding to larger market shares. We find that the market share of sustainable AUM is higher in European countries, which generally have stricter carbon regulations. This number is highest in Sweden (25%), followed by Spain (20%), Austria (17%), and Switzerland (17%).

2.2.3. Sustainable and traditional investment before and after climate policy

Table 1 summarizes the differences between sustainable and traditional investment before and after the announcement of climate policy, as well as their difference. We observe that, before the announcement, the weekly average sustainable *AUM growth* (32.4 bps), the growth rate of AUM, was 11 bps higher than the average traditional *AUM growth* (21.5 bps), and such a difference escalates by 10 bps to 21 bps after the climate policy is announced, which represents a 91% increase. Cumulative over a year (52 weeks), sustainable *AUM growth* after the climate policy announcement increases by 4% ($= (1 + 0.099\%)^{52} - 1$) relative to traditional *AUM growth*. Although sustainable AUM is relatively small in scale, they are growing faster than traditional investments, especially after the announcement of climate policy. This provides preliminary evidence that climate policy accelerates sustainable *AUM growth*.

Decomposing *AUM growth* into *Flow*, the ratio of weekly new capital flows to AUM, and *Return*, the weekly investment returns of existing investment positions, we find that both booming capital flows and improving investment returns contribute to the prosperity of sustainable investments. In particular, sustainable *Flow* outweighs traditional *Flow* by 18 bps before the climate policy is announced, and the wedge widens further, by 28% to 23 bps, after the announcement. Sustainable *Return* is on average 7 bps lower than traditional *Return* before the climate policy, but the gap shrinks by 71% to 2 bps and becomes statistically insignificant after the climate policy is announced. Compared to traditional *Return*, sustainable *Return* after the announcement improves by 5 bps per week (or 3% per year) relative to its pre-policy level. Overall, these summary statistics indicate that climate policy announcements accelerate the growth of sustainable investments by attracting new sustainable capital flows and improving sustainable investment returns.

We further show that the volatility of *AUM growth*, *Flow*, and *Return* are consistently higher for sustainable investments than traditional investments, both before and after the climate policy announcement. This suggests that sustainable investments are more volatile than traditional investments. However, such differences in risk exposure dip lower after the announcement as compared to their pre-policy levels. This provides preliminary evidence that the initiation of a climate policy improves the stability of sustainable investments.

2.3. Methodology

2.3.1. Baseline model

Governments worldwide have committed to adopting climate policy in different periods. The climate policy is expected to attract sustainable investments that pursue similar climate goals (treatment group) but not traditional investments that seek only financial returns. To evaluate the impact of climate policy on sustainable investments, we utilize a staggered DID approach to compare sustainable and traditional investments in each economy after the announcement of a climate policy, relative to those before the climate policy. In particular, we estimate the following model:

$$Y_{a,s,i,t} = \beta SRI_{a,s,i} \times CP_{i,t} + f_{a,s,i} + f_{a,t} + f_{i,t} + \varepsilon_{a,s,i,t} \qquad (1)$$

, where the subscripts a, s, i, and t respectively indicate asset class (equity or bond), sustainability indicator (sustainable or traditional investments), economy, and time. The dependent variable $Y_{a,s,i,t}$ could be $AUM\ Growth_{a,s,i,t}$, $Flow_{a,s,i,t}$, or $Return_{a,s,i,t}$, which respectively represent the asset growth, capital flow (normalized by AUM), and investment return in asset class a for investment type s in economy i at period t. It could also be the volatility of these three variables. The sustainability indicator, $SRI_{a,s,i}$, equals 1 for sustainable investments and 0 for traditional investments in asset class a in economy i. The climate policy dummy, $CP_{i,t}$, equals 1 after the announcement of the first ETS or carbon tax, and 0 before the policy announcement and for economies that have no official plan to implement any climate policies. The asset-sustainability-economy fixed effects $f_{a,s,i}$ absorb the idiosyncratic characteristics of equity and bond markets for sustainable and traditional investments across economies, such as the cultural preference for sustainable capital in some economies, the ease of trading equities relative to bonds, and the relative dominance of green and regular products in equity and bond markets, which could potentially affect the growth, allocation, and performance of different types of investment worldwide. The asset-time fixed effects $f_{a,t}$ take care of time-varying characteristics in different asset classes such as equity and bond market returns and their associated risks. The economy-time fixed effects $f_{i,t}$ capture the time-varying country characteristics that may affect the investment decisions and performances of both sustainable and traditional investments, such as economic growth prospects, financial stability, macroprudential policies, and regulations. Finally, $\varepsilon_{a,s,i,t}$ is the error term. To check the robustness of our estimation, we also employ different sets of fixed effects, alternative model specifications, and estimation techniques and control for additional variables results in Section 4.2.

The key parameter of interest is β, the coefficient of the interaction between sustainable investments and climate policy ($SRI_{a,s,i} \times CP_{i,t}$). If climate policy increases sustainable *AUM growth* (*Flow* and *Return*), β should be positive and statistically significant. Note that the difference between sustainable and traditional investments, which should be captured by a coefficient of $SRI_{a,s,i}$, is absorbed by asset-sustainability-economy fixed effects $f_{a,s,i}$, while the direct impacts of climate policy on *AUM growth*, *Flow*, and *Return*, which should be captured by a coefficient of $CP_{i,t}$, are absorbed by economy-time fixed effects $f_{i,t}$. We use alternative specifications to uncover these coefficients in robustness checks.

2.3.2. Announcement and implementation effects

There could be a significant time lag between the announcement and the implementation of any given climate policy. For example, China announced its intention to adopt national ETS in December 2017 but only officially launched it in July 2021. To capture potential forward-looking behaviour in international investments, we focus on the announcement instead of the actual implementation of climate policy. However, investors may not fully anticipate the impact of climate policy and may adjust their behaviour according to implemented carbon regulations. To check whether sustainable investments respond further to the implementation of climate policy, we expand Eq.(1) to include the interaction between $SRI_{a,s,i}$ and $CP_{i,t}^{Imp}$, a dummy that equals 1 after the implementation of climate policy:

$$Y_{a,s,i,t} = \beta SRI_{a,s,i} \times CP_{i,t} + \gamma^{Imp} SRI_{a,s,i} \times CP_{i,t}^{Imp} + f_{a,s,i} + f_{a,t} + f_{i,t} + \varepsilon_{a,s,i,t} \quad (2)$$

The coefficient of $SRI_{a,s,i} \times CP_{i,t}^{Imp}$ captures the additional response of sustainable investments to the implementation of climate policy on top of its announcement. If sustainable investments increase further in terms of *AUM growth*, *Flow*, and *Return* after the implementation of climate policy, γ^{Imp} should be positive and statistically significant. Otherwise, if investors have fully anticipated (overestimated) the impact of climate policy on their investments, γ^{Imp} should be statistically insignificant (negative and statistically significant).

2.3.3. Channels through which climate policy affects sustainable investment

To test whether climate policy attracts sustainable investment by mitigating climate change and/or improving financial risk-return trade-offs, we expand Eq.(1) to include a triple interaction term $SRI_{a,s,i} \times CP_{i,t} \times D_{i,t}^{Channel}$, where $D_{i,t}^{Channel}$ is a dummy that equals 1 for economies that benefit more from the climate policy in terms of climate mitigation, financial risk reduction, or financial returns improvement:

$$Y_{a,s,i,t} = \beta SRI_{a,s,i} \times CP_{i,t} + \rho^{Channel} SRI_{a,s,i} \times CP_{i,t} \times D_{i,t}^{Channel} + f_{a,s,i} + f_{a,t} + f_{i,t} + \varepsilon_{a,s,i,t}. \quad (3)$$

If climate policy attracts sustainable investment because it mitigates climate change, its impact should be more pronounced in economies that benefit more from climate policy in climate mitigation and adaptation. Similarly, if climate policy fosters sustainable investment because it improves financial gains, its impact should be stronger in economies with higher financial returns or lower financial risks for sustainable investment after climate policy. In both cases, the coefficient of the triple interaction term, ρ, should be positive and statistically significant. In our context, we define $D_{i,t}^{Channel}$ based on whether climate-policy-related reductions in carbon emissions, sustainable investment risks, and improvements in renewable energy generation, green technology innovations, and sustainable investment returns are above the sample median among economies that have officially committed to adopt a climate policy. Note that the definition of $D_{i,t}^{Channel}$ is conditional on the (scheduled) adoption of climate policy, that is, $CP_{i,t} = 1$; our regression model should not include $SRI_{a,s,i} \times D_{i,t}^{Channel}$, which is essentially the same as $SRI_{a,s,i} \times CP_{i,t} \times D_{i,t}^{Channel}$.

2.3.4. Heterogeneity across different climate policies

While most economies adopt either ETS or carbon tax to regulate emissions, some apply both. To understand which practices are more effective in attracting sustainable investment, we expand Eq.(1) to differentiate the roles of ETS and carbon tax:

$$Y_{a,s,i,t} = \beta SRI_{a,s,i} \times CP_{i,t} + \pi^{ETSonly} SRI_{a,s,i} \times CP_{i,t} \times D_{i,t}^{ETSonly} + \pi^{ETS\&Tax} SRI_{a,s,i} \times CP_{i,t} \times D_{i,t}^{ETS\&Tax} + f_{a,s,i} + f_{a,t} + f_{i,t} + \varepsilon_{a,s,i,t} \quad (4)$$

The dummy variable $D_{i,t}^{ETSonly}$ equals 1 when ETS but not carbon tax had been announced in economy i as of time t, and 0 otherwise. The dummy variable $D_{i,t}^{ETS\&Tax}$ equals 1 when the adoption of both ETS and carbon tax had been announced in economy i as of time t. Here, β, the coefficient of $SRI_{a,s,i} \times CP_{i,t}$, essentially captures the response of sustainable investments to carbon tax; $\pi^{ETSonly}$ and $\pi^{ETS\&Tax}$ capture the additional responses to ETS and the simultaneous presence of ETS and carbon tax. In other words, the impact of ETS on sustainable investments can be measured by $\beta + \pi^{ETSonly}$, while the impact of adopting both ETS and carbon tax can be measured by $\beta + \pi^{ETS\&Tax}$.

Similarly, to differentiate the roles of national and subnational climate policies, we estimate the following model:

$$Y_{a,s,i,t} = \beta SRI_{a,s,i} \times CP_{i,t} + \pi^{Subnational} SRI_{a,s,i} \times CP_{i,t} \times D_{i,t}^{Subnational} + \pi^{Both} SRI_{a,s,i} \times CP_{i,t} \times D_{i,t}^{Both} + f_{a,s,i} + f_{a,t} + f_{i,t} + \varepsilon_{a,s,i,t} \quad (5)$$

$D_{i,t}^{Subnational}$ and $D_{i,t}^{Both}$ are both dummy variables which equal 1 respectively when only sub-national climate policy, and when both sub-national and national climate policies, are adopted in economy i as of time t. The coefficient $\pi^{Subnational}$ measures the differential response of sustainable investments to sub-national and national climate policy, while the coefficient π^{Both} captures the additional response to simultaneous adoption of national and sub-national climate policies.

2.3.5. Heterogeneity across different sustainable investors

Our data allow us to further differentiate sustainable investors according to their characteristics and investment styles. To explore which types of sustainable investor respond more sensitively to climate policy, we estimate the following model:

$$Y_{a,s,i,t} = \beta SRI_{a,s,i} \times CP_{i,t} + \lambda^{Ind} SRI_{a,s,i} \times CP_{i,t} \times D_{a,i,t}^{Ind} + f_{a,s,i} + f_{a,t} + f_{i,t} + \varepsilon_{a,s,i,t} \ . \qquad (6)$$

The dummy variable $D_{a,i,t}^{Ind}$ equals 1 if sustainable investments in asset class a in economy i at period t meets the criteria defined by the superscript Ind. In our context, $D_{a,i,t}^{Ind}$ equals 1 if the market share of sustainable AUM, the fraction of sustainable AUM by foreign, institutional, ETF, or passive investors, is above the median value of all sustainable investments exposed to climate policy. If the responses of sustainable investors to climate policy are influenced positively by relatively large-scale sustainable AUM, greater penetration of foreign, institutional, ETF, or passive investors, the coefficient of the triple interaction term, λ^{Ind}, should be positive and statistically significant. Note that the definition of $D_{a,i,t}^{Ind}$ is conditional on climate policy: We are essentially comparing different types of sustainable investments provided they are affected by the climate policy; there is no need to include the interaction between $SRI_{a,s,i}$ and $D_{a,i,t}^{Ind}$.

3. Empirical results

We first present the baseline effects of climate policy on sustainable investments in Section 3.1. We then further decompose our findings into implement and announcement effects in Section 3.2, illustrate the dynamic effects in Section 3.3 and further analyze potential economic mechanisms in Section 3.4.

3.1. Baseline impact of climate policy on sustainable investments

Table 2 summarizes the impact of climate policy on sustainable investment. In column 1, we find that climate policy accelerates sustainable *AUM growth*—the coefficient of $SRI \times CP$, the interaction between the sustainable investment indicator and climate policy, is positive and statistically significant. In particular, the weekly average difference between sustainable and traditional *AUM growth* after the announcement of a climate policy is 0.504% higher than its pre-policy level. Cumulative over a year (52 weeks), our findings suggest that climate policy increases sustainable *AUM growth* by 30% (calculated as $(1 + 0.504\%)^{52} - 1$) per year. This number is much larger than the summary statistics because the DID approach carefully controls for the substantial cross-sectional differences that were averaged out in simple summary statistics.

To understand whether the positive response of sustainable *AUM growth* to climate policy is driven by fresh capital flows or growing investment returns, we decompose *AUM growth* into *Flow*, the new investment flows to a specific economy as a ratio of its AUM, and *Return*, the performance of existing investment positions. Columns 2 and 3 of Table 2 show that both *Flow* and *Return* increase in response to climate policy—the coefficients of $SRI \times CP$ are positive and statistically significant in both columns. This suggests that climate policy accelerates sustainable *AUM growth* by attracting fresh sustainable investment flows and enhancing sustainable investment returns. In particular, climate policy increases sustainable *Flow* and *Return* by 0.388% and 0.115% per week (or 23% and 7% per year), respectively. Out of the 0.504% weekly increase in sustainable *AUM growth* elicited by climate policy (see column 1 of Table 2), 77% (=0.388/0.504) comes from rising sustainable *Flow*, and 23% (=0.115/0.504) comes from improved sustainable *Return*. In other words, climate policy causes a disproportionate acceleration in the growth of sustainable investments by attracting fresh sustainable investment flows.

If one believes that climate policy raises public concerns over climate risks by explicitly imposing costs for carbon emissions, enforcing information disclosure, and campaigning for climate awareness, among other factors, our findings align with the existing literature that explores the effect of news-based climate shock on asset valuations. First, our finding that climate policy attracts fresh sustainable investment flows provides empirical support to Pastor et al.'s (2021) argument that climate concerns raise the demand for green assets. Second, our finding that climate policy improves sustainable investment returns is consistent with Ardia et al. (2020), Engle et al. (2020) and Huynh & Xia (2021), each of whom argue that climate concern increases the valuation of green assets relative to brown assets. Higher valuation of green assets today implies higher realized returns but lower expected returns for sustainable investments that favour green assets (Pastor et al., 2021). In this respect, our findings are also consistent with Bolton & Kacperczyk (2021) and Hsu et al. (2022), who argue that investors are especially minded to require lower returns for holding green assets when they are concerned about climate change.

Later in Section 4.2 we show that these baseline results remain robust when we perform a battery of checks using alternative model specifications, sample selections, estimation techniques, and controlling for additional variables.

3.2. Implementation versus announcement effects

Focusing on the announcement effects of climate policy enables us to capture forward-looking investment behaviour—adjustment of investment portfolios in anticipation of changing regulations on carbon emissions before their actual implementation. However, investors may either overreact or underreact to climate policy due to information asymmetry, overconfidence, and limited, asymmetric attention, among other factors (see, for example, Daniel et al., 1998; Kohlhas & Walther, 2021). Moreover, the implementation of climate policy may be different from what was expected by market participants or even the master plan laid out initially at the time of the policy announcement; if so, the introduction of new information may reshape investment decisions.

To differentiate the implement effects from the announcement effects, we estimate Eq.(2) and report the results in columns 4–6 of Table 2. The coefficients of $SRI \times CP^{Imp}$ are positive and statistically significant throughout columns 4–6. This suggests that the implementation of climate policy further accelerates sustainable *AUM growth*, attracts sustainable *Flow*, and boosts sustainable *Return* relative to the announcement of climate policy. In particular, sustainable *AUM growth* increases by another 0.274% per week after the implementation of climate policy, amounting to a total of 0.585% per week (or 35% per year) for implement effects, which is about twice as much as the announcement effect captured by the coefficient of $SRI \times CP$ (0.311% per week or 18% per year). Similarly, the implementation effects of climate policy on sustainable *Flow* and *Return* are almost double that of the corresponding announcement effects.

These results provide evidence that sustainable investments underreact to the climate policy after its announcement and before its implementation and expand more aggressively after the actual enforcement of the climate policy to incorporate new information. Note that the announcement effects measured by coefficients of $SRI \times CP$ remain positive and statistically significant in columns 4–6 of Table 2, which suggests that sustainable investments respond to the climate policy even before it becomes effective, thus highlighting the importance of accounting for announcement effects. This demonstrates that focusing on the post-implementation period of climate policies may lead to an underestimate of the policies' overall impact.

3.3. Dynamic effects

We next plot the dynamic effects of climate policy on sustainable investments from three years before to six years after the policy announcement, relative to traditional investments, to better understand the variations over time. Panel A of Figure 3 shows that, before the climate policy announcement, the difference between sustainable and traditional *AUM growth* is economically trivial and statistically insignificant, which justifies our application of a staggered DID approach. After the announcement of the climate policy, the difference between sustainable and traditional *AUM growth* increases persistently and eventually becomes statistically significant. There is no sign of reversal even after six years from the policy announcement. The shift in the dynamic effects mitigates the possibility that other factors could be driving our results, which allows us to ascribe the relative rise in sustainable *AUM growth* to climate policy.

We document similar evidence in Panel B of Figure 3, which shows that the differences between sustainable and traditional *Flow* are relatively small and statistically insignificant before the announcement of the climate policy but become larger and statistically significant after the announcement. Panel C of Figure 3 shows that the differences between sustainable and traditional *Return* are negative and statistically significant before the climate policy announcement but gradually increase and eventually become positive and statistically significant four years after the announcement. The result that sustainable investment returns are significantly lower than traditional investment returns before the climate policy, even after controlling for various factors, echoes our preliminary observations in Table 1. Note that such differences are quite stable before the policy announcement, which supports the parallel trend assumption and justifies our application of DID.

3.4. Economic mechanisms

We now turn to an exploration of the economic mechanisms underlying the impact of climate policy on sustainable investment. Sustainable investors pursue their social mandates on climate mitigation and adaptation while searching for financial returns. Their investment motivations can be pecuniary, nonpecuniary, or both. The pecuniary motive builds upon the notion of "doing well by doing good"—investors can improve investment returns and reduce investment risks as they seek to maximize inter-temporal profits over the long term (Benabou & Tirole, 2010). The nonpecuniary motive comes from the utility derived from holding green assets that finance climate-friendly activities and generate social impacts, which motivates investors to pay higher prices or accept lower expected returns for green assets (Pástor et al. 2021). Thus, climate policy may attract sustainable investments by (i) improving returns and reducing the risk of sustainable investment relative to traditional investment (pecuniary channel), (ii) mitigating climate change (nonpecuniary channel), or (iii) both. Many sustainable investment products have generated superior risk-adjusted returns in recent years, making it difficult to differentiate pecuniary and nonpecuniary incentives. The staggered introduction of climate policies worldwide has generated cross-economy variations in the extent of climate mitigation and risk-return profiles, which provides an ideal setting to examine these two incentives separately. Given that climate policy has started to exert impacts since its announcement, we focus on the average policy impact on sustainable investments in the post-announcement period in the following analysis and refer to it as climate policy effects unless otherwise specified.

3.4.1. Pecuniary channel

By putting a price on carbon, climate policy burdens carbon-intensive firms while benefiting carbon-light ones. This increases carbon-light firms' valuations relative to their carbon-intensive peers (Ardia et al., 2020; Engle et al., 2020; Huynh & Xia, 2021). Climate policy may not only increase the operation costs for carbon-intensive firms but may also cause some businesses to become stranded (van der Ploeg, 2016), as well as other consequences that are difficult to quantify (Barnett et al., 2020). Indeed investors track and price in stranded asset risks and other risks associated with carbon regulations (Krueger et al., 2020), which reduces the risk exposures of carbon-light firms relative to carbon-intensive ones (Ilhan et al., 2021; Seltzer et al., 2020). These studies imply that climate policy could potentially increase returns and reduce the risks of international sustainable investments which prioritize green assets associated with carbon-light activities in their portfolios.

To test whether the pecuniary channel is driving our result, that is, whether climate policy attracts sustainable investments because it increases financial returns and/or reduces financial risks, we need to address two questions. First, do sustainable investors anticipate the impacts of climate policy on investment risks and returns upon making their investment decisions? If not, then we can rule out the possibility that sustainable investments respond positively to climate policy because of their pecuniary incentives—pursuing social mandates in order to reap greater financial gains. If sustainable investors are aware of the financial impacts of climate policy, then we can proceed to the next question: Are sustainable investments more responsive to climate policies associated with larger return improvements and risk reductions? If sustainable investors' pecuniary incentives to optimize financial risk-return trade-offs are driving our result, they should increase investment when climate policy contributes more to return improvements or risk reductions. We then turn to test whether climate policy attracts sustainable investment through the pecuniary channels of improving financial returns and reducing financial risks.

For this analysis, we focus on sustainable *Flow*, which represents the allocation of new sustainable capital worldwide that carefully considers social impacts and risk-return trade-offs across markets. International capital flows have been well documented to chase returns and shun risks (Froot et al., 2001; Jinjarak et al., 2011). If sustainable *Flow* is driven by pecuniary incentives like traditional capital flows, it should respond more positively to climate policy associated with higher returns and lower risks. In the Appendix, we report the related results for sustainable *AUM growth* and *Return*, which may capture not only the flow of new information but also existing information.

Return improvements

We have documented evidence in Section 3.1 that climate policy improves sustainable investment returns, which is consistent with Ardia et al. (2020), Engle et al. (2020), and Huynh & Xia (2021). If sustainable investments were to reap the financial gains associated with climate policy, they should increase more substantially when climate policy contributes more to improved financial returns.

We first calculate the improvements in sustainable investment returns elicited by climate policy as the difference between sustainable and traditional investment returns in each of the post-policy period in excess of its pre-policy average. We then define $D_{i,t}^{Return}$ as a dummy that equals 1 if such policy-related return improvements are above the median value in the post-policy periods (among those committed to adopt climate policy), and 0 otherwise. Finally, we replace $D_{i,t}^{Channel}$ in Eq.(3) with $D_{i,t}^{Return}$ to explore the role of return improvements in shaping the responses of sustainable investment to climate policy. The coefficient of the triple interaction term $SRI \times CP \times D_{i,t}^{Return}$ in column 1 of Table 3 is positive but not statistically significant at the 5% level, which provides no evidence that sustainable *Flow* responds more positively to climate policies that yield greater return improvements. This coefficient becomes economically smaller and even less statistically significant when we further control for policy-related risk reductions (see column 3 in Table 3). Thus, there is a lack of statistical evidence that climate policy attracts sustainable *Flow* through the pecuniary channel of increasing investment returns.

This result is consistent with our observations in Table 1 (and later more formally in Table 7) that sustainable *Return* is consistently lower than traditional *Return* before the climate policy: If investors were to seek financial returns, they could be better off pursuing traditional investments rather than sustainable investments. Although sustainable *Return* increases after the climate policy, it is still lower than traditional *Return* on average (though not statistically significant). Thus, there is no need for investors to invest sustainably just to chase returns.

Risk reductions

Climate policy not only improves financial returns but also mitigates financial risks. We show in Appendix Table 3 that the volatility of sustainable *AUM growth*, *Flow*, and *Return* declines significantly by 25% to 30% relative to their traditional peers after climate policy. These results provide evidence that climate policy reduces the financial risk of sustainable investments.[5] Our findings accord with Seltzer et al. (2020) and Ilhan et al. (2021), who show that climate regulations increase the credit and tail risk of carbon-intensive firms relative to carbon-light ones, thus implying that sustainable investments that prioritize carbon-light assets should have lower risk exposures than traditional investments after the adoption of climate policy.

Could the pecuniary incentives of reducing financial risks drive the positive response of sustainable investments to climate policy? To test this hypothesis, we define $D_{i,t}^{Risk}$ as a dummy that equals 1 if climate-policy-related risk reduction, measured by the reversed difference in the volatility of return between sustainable and traditional investments in post-policy periods relative to the pre-policy average, is above the median value in the post-policy periods, and 0 otherwise. We then estimate Eq.(3) and report the result in column 2 of Table 3. The coefficient of $SRI \times CP \times D_{i,t}^{Risk}$ is negative and statistically significant, which suggests that sustainable *Flow* increases less in economies with greater risk reductions related to climate policy. This contradicts our conjecture that sustainable investments respond positively to climate policy because of the pecuniary incentive of reducing financial risks. This result remains robust after controlling for the effects of policy-related return improvements (see

[5] Note from Appendix Table 2 that the volatility of sustainable *AUM growth*, *Flow*, and *Return* are consistently higher than their traditional peers, suggesting that sustainable investments are riskier than traditional investments. Although the differences in the risks of sustainable and traditional investments shrink after the climate policy, they remain positive.

Column 3 of Table 3). This mitigates the concern that sustainable *Flow* is less responsive to climate policy with more risk reduction because it is also associated with lower returns.[6] These findings provide no statistical evidence that climate policy attracts sustainable *Flow* through the pecuniary channel of reducing financial risks.

It seems counter-intuitive that sustainable *Flow* increases more when climate policies are associated with lower risk reductions, but this is consistent with Zheng (2021), who finds that sustainable investors are willing to tolerate higher risks for their social impacts. We show in *Appendix Table 2* that the overall risks, measured by either the volatility of *Return*, *Flow*, or *AUM growth*, are consistently higher for sustainable investments than for traditional investments both before and after the climate policy, which is consistent with the growing literature on the green premium (see, for example, Baker et al., 2018; Pástor et al., 2021). If investors were to minimize risks, they could do a better job engaging in relatively low-risk traditional investments rather than the relatively high-risk sustainable investments. For those choosing sustainable investments, they must be willing to bear higher risks. If they were to act consistently, they should not switch to pursue risk reductions in their response to climate policy, which further undermines the possibility of the pecuniary channel. Our finding that these investors respond more positively to climate policies with lower risk reductions reflects the growth in sustainable investments that are accompanied by higher risks.

Summary of pecuniary channel

Overall, our findings cannot support the pecuniary channel that climate policy attracts sustainable investments because it improves sustainable investment returns or reduces sustainable investment risks. This suggests that improved returns and reduced risks of sustainable investment after the climate policy are the outcomes rather than the reasons for sustainable investments to respond positively to climate policy.

[6] We show in Appendix Table 4 that sustainable *Return* is indeed higher when climate policy contributes more to risk reductions, which is consistent with the risk-return trade-offs.

3.4.2. Nonpecuniary channel

We now turn to explore whether the nonpecuniary motives of sustainable investments are driving their responses to climate policy. Sustainable investors derive nonpecuniary benefits from their social impacts and are therefore willing to sacrifice financial returns for social impacts (Pástor et al. 2021). With increasing climate activism and growing awareness of climate change, it has become the priority for many to slow down the pace of global warming, so as to circumscribe the disastrous consequences from e.g., extreme weather events (such as heatwaves, floods, and droughts) and rising sea levels, which damage physical assets, economic production, and the ecosystem. Many investors, firms, and governments have pledged net-zero emissions to pursue the climate target set by the Paris Agreement—limiting the global temperature increase to 1.5 °C relative to pre-industrial levels. In the current context, sustainable investors' social mandates largely lie in the areas of climate mitigation and adaptation. Thus, climate policies that are more effective in climate mitigation and adaptation should attract more sustainable investment originating from the nonpecuniary incentives of pursuing social impacts. We test this nonpecuniary channel by exploring the cross-country variations in carbon reductions, renewable energy generation, and green technology innovations elicited by different climate policies. Again, we focus on *Flow*, the new investments that enable us to explore their responses to the latest information related to climate policy. If sustainable *Flow* is driven by the nonpecuniary incentives, it should be more responsive to climate policies that contribute more to climate mitigation and adaptation.

Carbon emission reductions

Climate policy is effective in reducing carbon emissions (Bayer & Aklin, 2020), but its efficiency varies across economies. While investors may not have a perfect understanding of the factors underlying the effectiveness of climate policies, they can derive related information from the observed emission reductions in order to inform their investment decisions. To align with their social mandates, we expect sustainable investments to respond more aggressively to climate policies associated with greater carbon reductions that slow down global warming. To test this hypothesis, we create a dummy $D_{i,t}^{Carbon}$ that equals 1 if the carbon reductions elicited by climate policy are above the sample median, and 0 otherwise. To improve comparability across economies, the policy-related carbon reductions in each economy are calculated as the carbon emissions in each post-policy period that exceed the pre-policy average normalized by the latter. We replace $D_{i,t}^{Channel}$ in Eq.(3) with $D_{i,t}^{Carbon}$ to explore whether sustainable *Flow* responds more positively to climate policies associated with greater carbon reductions.

Column 1 of Table 4 shows that the coefficient of $SRI \times CP \times D_{i,t}^{Carbon}$ is positive and statistically significant, which suggests that sustainable *Flow* increases more substantially when climate policy is associated with greater carbon reductions. This provides evidence that climate policy attracts sustainable investment by reducing carbon emissions, which aligns with sustainable investments' social mandate on climate mitigation.

Renewable energy adoption and generation

Climate policy could also promote renewable energy generation when aided by public subsidy (Lin & Jia, 2020). Scaling up the adoption of renewable energy sources such as solar and wind power, that have extremely low carbon footprints, could substantially reduce emissions. But this is only possible when there is sufficient generation capacity to supply the energy needed for the economy, provided that energy storage technologies enable fast and long-duration storage and efficient release of renewable energy at low cost. Greater efforts and resources have been directed into improving the capacity of generating renewable energy after the climate policy, which could be translated into greater adoption of renewable energy and therefore more substantial carbon reductions, not only in the present but also in the future. If improvements in renewable energy generation caused by climate policy attract sustainable investment, the policy's impact should be more pronounced when it better promotes renewable energy.

We define $D_{i,t}^{Renewable}$ as a dummy that equals 1 if the increase in renewable energy generation elicited by the climate policy is above the sample median, and 0 otherwise, replace it with $D_{i,t}^{Channel}$, and estimate Eq.(3). The coefficient of $SRI \times CP \times D_{i,t}^{Renewable}$ in column 2 of Table 4 is positive and statistically significant, suggesting that sustainable *Flow* responds more aggressively to climate policies associated with greater improvements in renewable energy generation. This supports our hypothesis that climate policy attracts sustainable investment by improving renewable energy generation in ways that contribute to climate mitigation and adaptation.[7]

Green technology innovations

Climate policy sparks green technology innovations as firms seek to reduce or profit from emission costs (Cui et al., 2018). These advances in green technologies could be translated into climate mitigation and adaptation. For example, technology that enhances the capacity and duration of battery storage would promote the popularity of electric vehicles that have much lower carbon footprints than conventional vehicles. Thus, sustainable investments should place a higher value on any climate policy that encourages more green innovations and therefore contributes to future climate mitigation and adaptation.

To test this hypothesis, we define $D_{i,t}^{Technology}$ as a dummy that equals 1 if the increase in green technology innovation elicited by climate policy is above the sample median, and 0 otherwise, replace $D_{i,t}^{Channel}$ with $D_{i,t}^{Technology}$, and estimate Eq.(3). The result in column 3 of Table 4 supports our conjecture that sustainable investments are more responsive to climate policies associated with a higher level of green technology innovation—the coefficient of $SRI \times CP \times D_{i,t}^{Technology}$ is positive and statistically significant. This provides evidence that climate policy attracts sustainable investments by fostering green technology innovations.

Summary of nonpecuniary channel

To summarize, climate policies that contribute more to carbon emission reductions, renewable energy generation, and green technology innovations attract more sustainable investments. This provides evidence to support the nonpecuniary incentives of sustainable investments, which respond more positively to climate policies that contribute more to climate mitigation and adaptation.

[7] We document similar evidence in Appendix Table 5, which shows that more adoption of renewable energy also enhances the impact of climate policy on sustainable investment.

3.4.3. Discussion

We have shown that international sustainable investments are more responsive to climate policies associated with better climate mitigation and adaptation, but not those that yield higher returns and lower risks. These findings are consistent with the nonpecuniary incentives of sustainable investments highlighted in Pastor et al. (2021), but not the pecuniary incentives presented in Benabou & Tirole (2010). This means that higher returns and lower risks following the adoption of a climate policy are the outcome rather than the motivation of sustainable investments that respond to such policies. Thus, our findings provide empirical support to Pastor et al.'s (2021) argument that the recent outperformances of some sustainable investment products reflect growing sustainable investments elicited by climate shocks and are not a good indicator to motivate sustainable investing.

In recent years, regulators have put increasing effort into screening for potential greenwashing, which involves misleading or exaggerating green practices to attract investors. For example, the US Securities and Exchange Commission (SEC) fined BNY Mellon $1.5mn in May 2022 for allegedly misstating and omitting information about how they applied ESG and related green criteria to their investments. Despite the malpractice of some, our findings on the nonpecuniary channel suggest that the majority are pursuing their social mandates with integrity, directing capital to reward, whereas climate policy generates greater impacts on climate mitigation and adaptation. The incentives for greenwashing appear low—investors can be financially better off engaging in traditional investments that generally generate higher returns and lower risks both before and after the climate policy than sustainable investments (see Table 1, *Appendix Table 2*, and Appendix Table 3).

4. Further analysis

In this section, we perform additional heterogeneity analysis and robustness checks to better understand the impact of climate policy on sustainable investment.

4.1. Heterogeneity analysis

The mix of ETS and carbon tax at national and sub-national levels produces variations in the stringency of carbon regulations across economies, which allows us to better explore their heterogeneous impacts on sustainable investment. We are also interested in how the scale and composition of sustainable investments shape their responses to climate policy.

4.1.1. ETS versus carbon tax

ETS and carbon tax are the two major policy instruments for carbon regulation. While some economies adopt either ETS or carbon tax, others impose both to strengthen the regulations. There are debates on whether ETS or carbon tax is more effective in regulating carbon emissions. However, little is known about their implications for sustainable investments. To investigate the heterogeneous impacts of different climate policies on sustainable investments, we group economies into three categories according to whether they commit to (i) only carbon tax, (ii) only ETS, or (iii) both ETS and carbon tax at a given point of time, estimate Eq.(4), and report the estimation results in Panel A of Table 5.

We observe two important findings. First, the coefficients of $SRI \times CP \times D^{ETS}$ are economically small and statistically insignificant throughout columns 1–3, suggesting no statistical difference in the impacts of ETS and carbon tax on sustainable *AUM growth*, *Flow*, and *Return*. Second, the coefficients of $SRI \times CP \times D^{ETS\&Tax}$ are positive and statistically significant in columns 1 and 3, which means that economies that commit to both ETS and carbon tax enjoy higher sustainable *AUM growth* and *Return* than those that commit to only carbon tax. Faster sustainable *AUM growth* is driven by better sustainable *Return*, but not larger sustainable *Flow*, which does not increase significantly when both ETS and carbon tax are in place (see column 2 of Table 5).

4.1.2. National versus subnational climate policy

In some economies, carbon regulations are applied to the whole nation, while in others, such regulations are limited to certain cities or states. Firms may arbitrate among cities within a nation to reduce their carbon emission costs in the presence of a subnational climate policy. If the climate policy is nationwide, firms can only invest abroad to bypass carbon emission costs, which is much more difficult given the higher barriers to cross-border investment. This implies that national climate policy is more likely to motivate firms to engage in clean production and green innovation to save emission costs than subnational climate policy. This is more encouraging to sustainable investors who seek to mitigate climate change and improve social welfare. We therefore expect sustainable capital to respond more positively to national climate policy than subnational climate policy.

To differentiate the roles of climate policy rolled out in different scales, we estimate Eq.(5) and report the results in Panel B of Table 5. Consistent with our conjecture, we find that subnational climate policies contribute less to increasing sustainable *AUM growth* and *Flow* (see columns 1 and 2) but do not affect sustainable *Return* (see column 3). Having both national and subnational climate policies enhances the impact of climate policy on sustainable *AUM growth*, *Flow*, and *Return*.

4.1.3. Carbon price and tax

We further measure the stringency of carbon regulations by carbon costs. Higher carbon costs motivate firms to turn greener to reduce production and operation costs, which contributes in turn to climate mitigation and adaptation that attracts sustainable investment. We therefore expect the impact of climate policy to be stronger when carbon costs are higher.

We measure carbon costs by the market-based carbon price for ETS, and the government-set tax rate associated with carbon tax, respectively. To test the hypothesis, we create two dummy variables, $D^{HighCarbonPrice}$ and $D^{HighCarbonTax}$, which equal 1 respectively if the carbon price and carbon tax are above the sample median. We then estimate Eq.(3) by replacing $D^{Channel}$ with $D^{HighCarbonPrice}$ and $D^{HighCarbonTax}$ respectively to understand the role of carbon costs in reshaping the impact of climate policy. The result in

Panel C of Table 5 show that higher carbon prices strengthen the response of sustainable *AUM growth* and *Flow* to climate policy, which is consistent with our previous finding that tighter regulations attract sustainable investment. However, we find that higher carbon prices weaken the positive response of sustainable *Return* to climate policy, possibly because they signal greater commitment to combat climate change and therefore enhance sustainable investors' willingness to sacrifice even more returns i.e., by holding a wider range of green assets that yield lower returns than their existing portfolio.

The role of higher carbon tax is not as pronounced as carbon prices. We find no evidence in panel D of Table 5 that higher carbon tax affects the impact of climate policy on sustainable investment. One possible reason is that investors have priced in carbon tax set by government, which is relatively stable and predictable—after all, it takes a lengthy legislative process for governments to alter carbon tax. The positive impacts of carbon prices and the ineffectiveness of carbon tax in shaping the response of sustainable investments to climate policy are each consistent with Zheng (2021), which documents similar evidence in the context of green bonds.

4.1.4. The scale of sustainable investments

Sustainable investments are likely to generate a greater impact upon climate change when reaching a certain scale. The same amount of sustainable new capital should be more impactful in economies that have accumulated larger sustainable AUM, which strengthens the response of sustainable investments to climate policy. Comparing sustainable investments in economies with relatively large and small shares of sustainable AUM in the capital market, we show in panel A of Table 6 that sustainable investments are more responsive to climate policies in economies that already have a relatively large sustainable AUM. We further show in panels B–E of Table 6 that sustainable *AUM growth*, *Flow*, and *Return* respond more positively to climate policies in markets more dominated by foreign, institutional, ETF, and passive investors.

4.2. Robustness checks

We further test the robustness of our results using alternative model specifications and sample selections, while controlling for additional variables.

4.2.1. Possibly endogenous climate policy

There are two sources of endogeneity—the omitted variable bias and the reverse causality. One maybe concerned that both climate policy and sustainable investments can be driven by common factors such as the ecosystem, geographical environment, social preference, climate activism, and industrial structure, among many others. We have absorbed these potential common drivers by controlling for economy-time fixed effects, which addresses the concern of omitted variables bias. Another concern is that policymakers may introduce climate policy to attract sustainable investments, leading to reverse causality. We argue that this is unlikely for several reasons. First, there was no evidence in the existing literature that climate policy attracts sustainable capital, which cannot justify the increasing adoption of climate policy before the sustainable investments become relatively visible. Second, the costs of climate policy in increasing production costs and reducing firms' competitiveness significantly dominated its side effects in attracting sustainable—despite its rapid growth, the absolute size and market share of sustainable investments remain relatively small, which cannot rationalize the policymaking.

We further address the reverse causality concern by focusing on climate policies announced before the 2015 Paris Agreement, when sustainable investments are too small to catch attention. If our baseline results are driven by the reverse causality, in an environment when sustainable investments are too trivial to influence policymaking decisions, we should no longer find any evidence that climate policies attract sustainable investments. In contrast, we continue to document evidence in Appendix Table 6 that climate policy that is unlikely to be motivated by sustainable investments attract sustainable investments. We document similar evidence when focusing on climate policies announced before the 2007 global financial crisis (not reported). These results mitigate the concern of reverse causality.

4.2.2. Sustainable and traditional investments in the absence of climate policy

The coefficient of SRI, which captures the difference between sustainable and traditional investments in the absence of climate policy, is absorbed by the fixed effects. To uncover the difference, we remove the fixed effects related to the sustainability label and repeat the analysis. Table 7 shows the robustness of our baseline results that sustainable *AUM Growth*, *Flow* and *Return* increase in response to climate policy. Moreover, consistent with the summary statistics in Table 1, we find that, in the absence of climate policy, (i) sustainable *AUM Growth* and *Flow* are significant higher, while sustainable *Return* is lower than traditional investments, and (ii) the volatility of sustainable *AUM Growth*, *Flow*, and *Return* are significantly larger than traditional investments. This suggests that sustainable investments are generating lower returns while exposing the investor to higher risks than traditional investments conducted before the climate policy. Note that the coefficient sum of SRI and $SRI \times CP$ is negative (-0.006%) associated with a *p-value* of 0.21, which means that sustainable *Return* is lower than traditional *Return* after climate policy but not statistically significant. This further supports the nonpecuniary incentives of sustainable investment—they could have earned better returns (or at least at par) by switching to traditional investments if they were driven by pecuniary incentives.[8]

4.2.3. Alternative model specifications

We have controlled for a large set of fixed effects throughout our regressions to mitigate potential concerns over confounding factors. However, one may still be concerned about heterogeneous equity and bond market performance across the countries driving our results. To mitigate this concern, we further control for class-economy-week fixed effects and report the results in Appendix Table 7. Consistent with our baseline regression, we find that sustainable *AUM Growth*, *Flow*, and *Return* increase in response to climate policy. Our key results are also robust when loosening the specifications of fixed effects relative to Eq.(1) by (i) replacing the weekly time related fixed effects with monthly related fixed effects (see columns 4–6), (ii) dropping class-week fixed effects (see columns 7–9), or (iii) downgrading class-week and economy-week fixed effects to only week fixed effects (see columns 10–12).

[8] We document similar evidence that sustainable investment yields lower return than traditional investments both before and after the climate policy in Table 1.

4.2.4. Sustainable investments in equity and bond markets

So far, we have pooled sustainable investments in equity and bond markets in our regressions. To check whether our baseline results are robust across different asset classes, we repeat the analysis for equity and bond investments separately. Appendix Table 8. Sustainable investments in equity and bond markets. Appendix Table 8 shows that in both the equity and bond market, climate policy increases sustainable *AUM Growth*, *Flow*, and *Return* and reduces their associated volatility. It is worth noting that rising sustainable *Flow* contributes more to the fast *AUM Growth* after climate policy in the bond market than in the equity market.

4.2.5. The rise of sustainable investments or the fall of traditional investments?

We drive the financial impacts of climate policy based on the comparison between sustainable and traditional investments using the DID approach. One may wonder whether the issue at stake is the rise of sustainable investments or the fall of traditional investments. To answer this question, we separately estimate the difference in sustainable and traditional investments between post- and pre-policy periods. We show in the left panel of Appendix Table 9 that sustainable *AUM Growth* and *Flow* increase after climate policy when compared to their pre-policy levels, however sustainable *Return* is not statistically different between post- and pre-policy periods. On the right panel of Appendix Table 9, we find no statistical evidence that traditional *AUM Growth*, *Flow* and *Return* differ between post- and pre-policy periods. These results imply that the positive response of sustainable investments reflects the growth of that area rather than the decline of traditional investments.

4.2.6. Additional control variables

Could historical investment flows and returns confound the impact of climate policy upon sustainable investment? The dynamic effects of climate policy in Figure 3 show that this is unlikely—otherwise the difference between sustainable and traditional investments should have widened even before the announcement of the climate policy. To further mitigate this concern, we control for lagged *Flow* and *Return* as well as their volatilities. Appendix Table 10 documents consistent results showing that climate policy increases robust, sustainable *AUM Growth*, *Flow*, and *Return*. Controlling for additional lags of *Flow* and *Return*, or their associated volatility measures, does not affect our key results either (not reported).

5. Conclusions

Studies have thoroughly documented the social impacts of climate policy in slowing down global warming, reducing carbon emissions, sparking renewable energy adoption and generation, and encouraging green technology innovations, among many other positive factors. These findings bridge the gap between climate policy and sustainable investments that pursue the same social mandates of climate mitigation and adaptation and provide a foundation for our study. Utilizing the staggered adoption of climate policy worldwide, we evaluate the impact on international sustainable investments using a DID approach that compares sustainable and traditional investments in the same economy after the announcement of climate policy, relative to their pre-announcement patterns. We document significant and robust evidence that climate policy improves the returns and reduces the risks of sustainable investment, thereby producing an increase in such investment. These impacts are particularly pronounced when both ETS and carbon tax are in place, especially when the carbon price is relatively high and when the climate policy is implemented at a national rather than sub-national scale. Further analysis reveals that climate policies that contribute more to carbon emission reductions, renewable energy generation, and green technology innovations attract more sustainable investment, which provides empirical support to the nonpecuniary incentives of sustainable investing highlighted in Pástor et al. (2021b). However, there is no evidence that climate policies associated with greater return improvements and risk reductions attract sustainable investment, which mitigates concerns over potential greenwashing in the international market.

Our findings uncover new financial benefits of climate policy in the context of international sustainable investment. This points to a new direction of leveraging international capital to create a sustainable path towards low carbon economies through policy making: the market-based carbon costs motivate firms to enhance their climate mitigation and adaptation activities, which in turn attract international sustainable investments that further support firms' climate-friendly activities. Our results also endorse the international sustainable investors' efforts to pursue their social mandates by rewarding climate policies that are more effective in mitigating climate changes. This implies that tightening carbon regulations that contribute more to carbon emissions may be economically costly for carbon-intensive firms, but financially rewarding for the capital market, as this would improve the returns and reduce the risks of sustainable investment. It is important to consider the financial impacts of climate policy when evaluating its costs and benefits.

Figure 1. Time trends of sustainable and traditional investments worldwide

This figure plots the weekly aggregate assets under management (AUM) in trillion US$ by sustainable and traditional investments worldwide in solid and dashed lines, respectively, from 2000 to 2021.

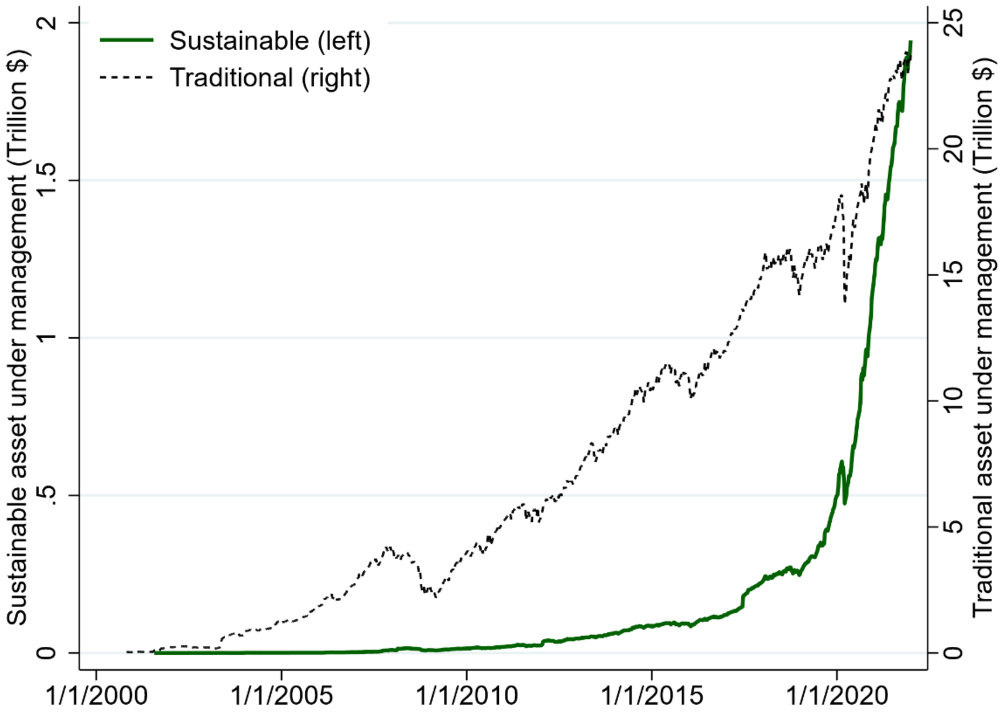
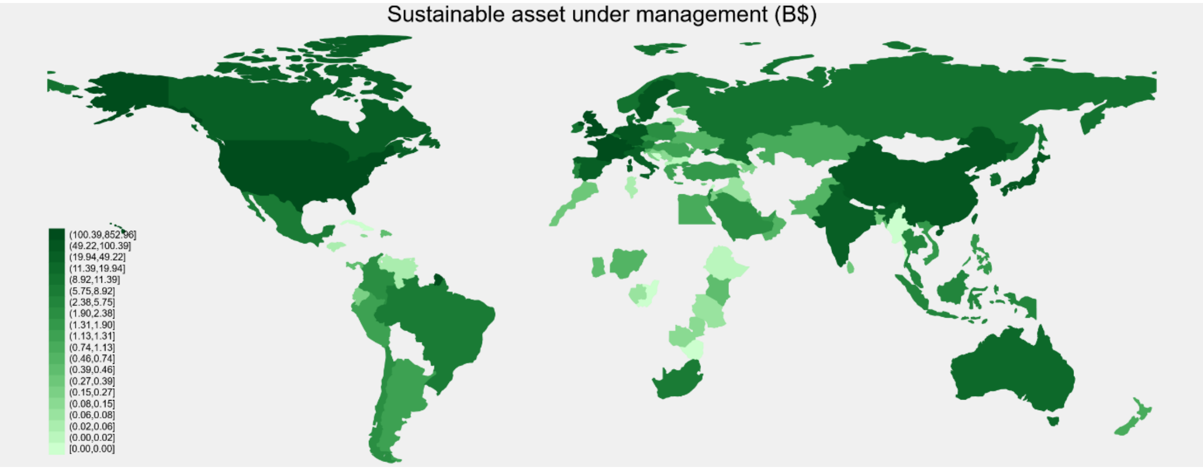


Figure 2. Global distribution of sustainable investments

Panel A illustrates the size of sustainable asset under management (AUM) in billion dollars (B$) across countries by the end of 2021, with darker colour corresponding to larger AUM. Panel B demonstrates the ratio of sustainable AUM to total AUM in each country, with darker colour representing greater ratio of sustainable AUM.

Panel A: Sustainable AUM (B$)



Panel B: Share of sustainable AUM (%)

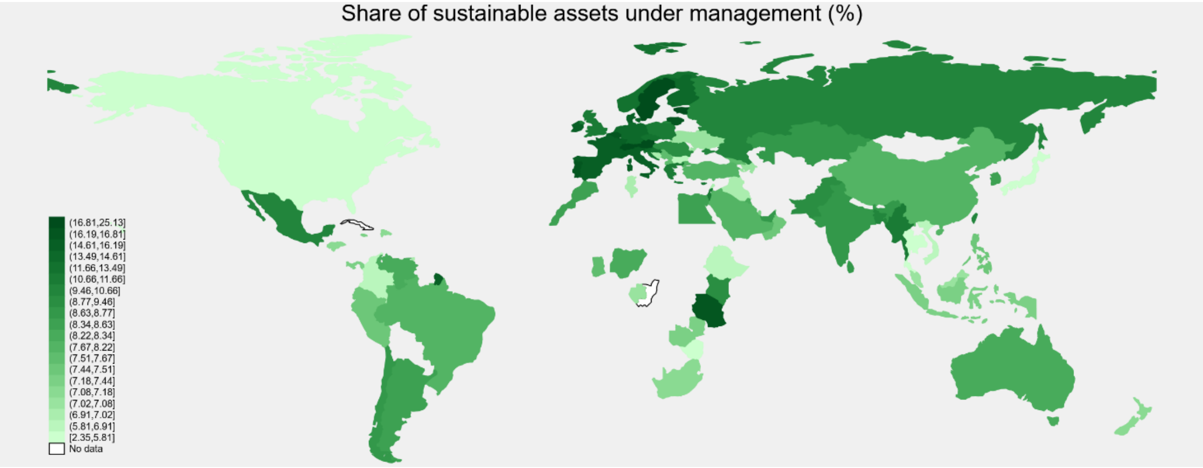
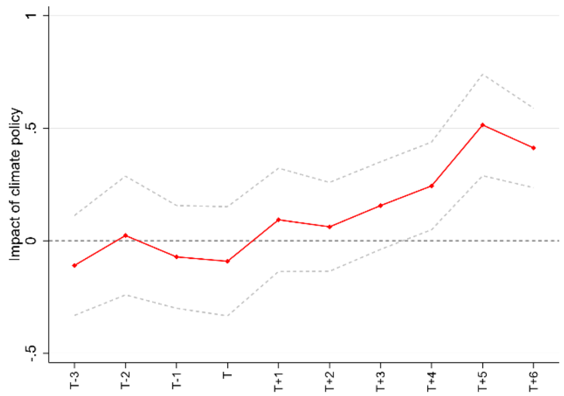


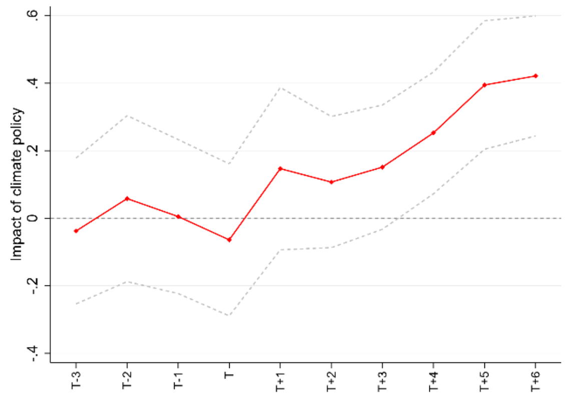
Figure 3. Dynamic effects of climate policy on sustainable investments

Panels A, B, and C illustrate respectively the difference between sustainable and traditional AUM growth, Flow, and Return from three years before the announcement of the climate policy to six years after, in solid line. The dashed lines are the 95% confidence intervals. AUM growth is the growth of asset under management (AUM) in an economy, Flow is the dollar amount of capital flow as a ratio of AUM, and Return is the investment returns. All regressions control for sustainability-asset-economy, asset-time, and economy-time fixed effects with heterogeneity robust standard error clustered by economy.

Panel A: *AUM growth*



Panel B: *Flow*



Panel C: *Return*

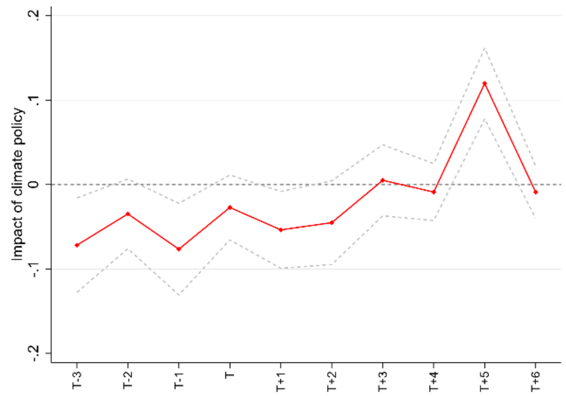


Table 1. Summary statistics

This table summarizes the mean and standard deviation (SD) of sustainable (treatment group) and traditional (control group) investments and their difference. *AUM growth* is the growth of asset under management (AUM) in an economy, *Flow* is the dollar amount of capital flow as a ratio of AUM, and *Return* is the investment returns. *Before* and *After* refer to the periods before and after the announcement of the climate policy, respectively. *DID* is the difference between sustainable and traditional investments after the climate policy, relative to that before the climate policy. All statistics are in percentage points.

	(1)	(2)	(3)	(4)	(5)	(6)
	Sustainable		Traditional		Sustainable – Traditional	
	Mean	SD	Mean	SD	Difference	p-value
AUM growth						
Before	0.325	0.010	0.201	0.008	0.125	0.000
After	0.324	0.011	0.117	0.011	0.208	0.000
DID					0.083	0.000
Flow						
Before	0.267	0.005	0.082	0.005	0.186	0.000
After	0.248	0.006	0.024	0.006	0.224	0.000
DID					0.038	0.000
Return						
Before	0.058	0.008	0.119	0.007	-0.061	0.000
After	0.076	0.009	0.092	0.009	-0.016	0.179
DID					0.045	0.005

Table 2. Impacts of climate policy on sustainable investments

This table reports the estimated treatment effects of climate policy on sustainable investments, which is further decomposed into announcement and implementation effects. The sustainable indicator *SRI* equals 1 for sustainable investments (treatment group) and 0 for traditional investments (control group). The post-treatment dummy *CP* equals 1 after the announcement of the climate policy, and 0 otherwise. The post-implementation dummy variable CP^{Imp} equals 1 after the official implementation of climate policy, and 0 otherwise. The dependent variable *AUM growth* is the growth of asset under management (AUM) in an economy, *Flow* is the capital flows normalized by corresponding AUM, and *Return* is the investment returns. All regressions control for sustainability-asset-economy, asset-time, and economy-time fixed effects. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline			**Announcement versus Implement**		
	AUM growth	*Flow*	*Return*	*AUM growth*	*Flow*	*Return*
$SRI \times CP$	0.503***	0.388***	0.115***	0.305***	0.238**	0.067***
	(0.046)	(0.042)	(0.010)	(0.101)	(0.091)	(0.019)
$SRI \times CP^{Imp}$				0.283***	0.215**	0.068***
				(0.100)	(0.090)	(0.018)
Constant	0.136***	0.075***	0.061***	0.124***	0.066***	0.058***
	(0.009)	(0.008)	(0.002)	(0.010)	(0.009)	(0.002)
Observations	276,961	276,961	276,961	276,961	276,961	276,961
R-squared	0.776	0.412	0.912	0.776	0.413	0.912

Table 3. The pecuniary channel of financial return and risks

This table summarizes how sustainable *Flow* respond to climate policies associated with different financial return and risk levels. The dependent variable *Flow* is the dollar amount of capital flow as a ratio of AUM. The sustainable indicator *SRI* equals 1 for sustainable investments (treatment group), and 0 for traditional investments (control group). The post-treatment dummy *CP* equals 1 after the announcement of the climate policy, and 0 otherwise. The dummy D^{Return} equals 1 when the difference between sustainable and traditional investment returns after the climate policy, relative to its pre-policy level, is above the sample median, and 0 otherwise. Similarly, the dummy D^{Risk} equals 1 when the difference between sustainable and traditional investment return volatility after the climate policy, relative to its pre-policy level, is below the sample median. All regressions control for sustainability-asset-economy, asset-time, and economy-time fixed effects. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1) $Flow$	(2) $Flow$	(3) $Flow$
$SRI \times CP$	0.373***	0.445***	0.431***
	(0.039)	(0.037)	(0.034)
$SRI \times CP \times D^{Return}$	0.032*		0.026
	(0.016)		(0.016)
$SRI \times CP \times D^{Risk}$		-0.094***	-0.092***
		(0.024)	(0.024)
Observations	276,961	276,961	276,961
R-squared	0.412	0.413	0.413

Table 4. The nonpecuniary channel of climate mitigation and adaptation

This table summarizes how sustainable *Flow* respond to climate policies associated with different levels of climate mitigation and adaptation. The dependent variable *Flow* is the dollar amount of capital flow as a ratio of AUM. The sustainable indicator *SRI* equals 1 for sustainable investments (treatment group), and 0 for traditional investments (control group). The post-treatment dummy *CP* equals 1 after the announcement of the climate policy, and 0 otherwise. The dummy variables D^{Carbon}, $D^{Renewable}$ and $D^{Technology}$ equal 1, respectively, when the reductions of carbon emissions, the improvements to renewable energy generation and green technology innovations after the climate policy's introduction, relative to their pre-policy levels, are above the sample median, and 0 otherwise. All regressions control for sustainability-asset-economy, asset-time, and economy-time fixed effects. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1) $Flow$	(2) $Flow$	(3) $Flow$	(4) $Flow$
$SRI \times CP$	0.360***	0.370***	0.383***	0.356***
	(0.051)	(0.053)	(0.048)	(0.054)
$SRI \times CP \times D^{Carbon}$	0.105***			0.088*
	(0.039)			(0.052)
$SRI \times CP \times D^{Renewable}$		0.073**		0.023
		(0.037)		(0.054)
$SRI \times CP \times D^{Technology}$			0.092**	0.025
			(0.038)	(0.059)
Observations	245,950	245,950	245,950	245,950
R-squared	0.420	0.420	0.420	0.420

Table 5. Stringency of climate policy

This table summarizes how sustainable investments respond to different types of climate policy representing various levels of carbon regulation stringency. The sustainable indicator *SRI* equals 1 for sustainable investments (treatment group), and 0 for traditional investments (control group). The post-treatment dummy *CP* equals 1 after the announcement of the climate policy, and 0 otherwise. In panel A, the dummy variable $D_{i,t}^{ETS}$ ($D_{i,t}^{ETS\&Tax}$) equals 1 if economy i commits to adopt only ETS (both ETS and carbon tax) at period t. In panel B, the dummy variable $D_{i,t}^{Subnational}$ ($D_{i,t}^{Both}$) equals 1 if the economy rolls out climate policy at only subnational (both subnational and national) level. In panels C and D, the dummy variables $D^{HighCarbonPrice}$ and $D^{HighCarbonTax}$ equal 1 respectively if the carbon price and tax are above the sample median. The dependent variable *AUM growth* is the growth of asset under management (AUM) in an economy, *Flow* is the capital flows normalized by corresponding AUM, and *Return* is the investment returns. All regressions control for sustainability-asset-economy, asset-time, and economy-time fixed effects. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1) *AUM growth*	(2) *Flow*	(3) *Return*
A: ETS versus carbon tax			
$SRI \times CP$	0.464***	0.369***	0.095***
	(0.071)	(0.071)	(0.017)
$SRI \times CP \times D^{ETS}$	0.003	-0.009	0.013
	(0.086)	(0.087)	(0.020)
$SRI \times CP \times D^{ETS\&Tax}$	0.216**	0.143	0.073***
	(0.084)	(0.092)	(0.021)
B: National vs subnational policy			
$SRI \times CP$	0.508***	0.399***	0.109***
	(0.050)	(0.046)	(0.011)
$SRI \times CP \times D^{Subnational}$	-0.291***	-0.313***	0.022
	(0.061)	(0.058)	(0.019)
$SRI \times CP \times D^{Both}$	0.263**	0.221*	0.043***
	(0.125)	(0.113)	(0.014)
C: High vs low carbon price			
$SRI \times CP$	0.369***	0.228***	0.141***
	(0.053)	(0.047)	(0.012)
$SRI \times CP \times D^{HighCarbonPrice}$	0.171***	0.202***	-0.032***
	(0.037)	(0.033)	(0.008)
D: High vs low carbon tax			
$SRI \times CP$	0.582***	0.456***	0.126***
	(0.050)	(0.052)	(0.015)
$SRI \times CP \times D^{HighCarbonTax}$	-0.101*	-0.087	-0.014
	(0.056)	(0.059)	(0.019)

Table 6. The scale and composition of sustainable investment

This table reports the estimated impact of climate policy on sustainable investment. The sustainable indicator *SRI* equals 1 for sustainable investments (treatment group), and 0 for traditional investments (control group). The dummy variable *CP* equals 1 after the announcement of the climate policy. The dummy variable $D_{a,i,t}^{HighSRI}$ equals 1 if the share of sustainable investments in economy i and asset class i at period t is above the sample median, and 0 otherwise. The dependent variable *AUM growth* is the growth of asset under management (AUM) in an economy, *Flow* is the dollar amount of capital flow as a ratio of AUM, and *Return* is the investment returns. All regressions control for sustainability-asset-economy, asset-time, and economy-time fixed effects. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1) *AUM growth*	(2) *Flow*	(3) *Return*
A: High vs low sustainable investments			
$SRI \times CP$	0.350***	0.263***	0.087***
	(0.047)	(0.045)	(0.012)
$SRI \times CP \times D^{HighSRI}$	0.277***	0.226***	0.051***
	(0.030)	(0.034)	(0.007)
B: High vs low foreign ownership			
$SRI \times CP$	0.344***	0.257***	0.087***
	(0.045)	(0.043)	(0.011)
$SRI \times CP \times D^{HighForeign}$	0.284***	0.233***	0.050***
	(0.032)	(0.035)	(0.007)
C: High vs low institutional investors			
$SRI \times CP$	0.314***	0.222***	0.092***
	(0.044)	(0.041)	(0.011)
$SRI \times CP \times D^{HighSRI}$	0.316***	0.277***	0.039***
	(0.027)	(0.029)	(0.005)
D: High vs low ETF investment			
$SRI \times CP$	0.430***	0.302***	0.129***
	(0.051)	(0.047)	(0.011)
$SRI \times CP \times D^{HighSRI}$	0.131***	0.154***	-0.023***
	(0.040)	(0.038)	(0.007)
E: High vs low passive investment			
$SRI \times CP$	0.419***	0.310***	0.109***
	(0.053)	(0.049)	(0.011)
$SRI \times CP \times D^{HighSRI}$	0.137***	0.127***	0.010
	(0.044)	(0.043)	(0.006)

Table 7. Sustainable versus traditional investments

This table summarizes the difference between sustainable and traditional investments conditional on the presence and absence of climate policy, as well as the direct impact of climate policy. The sustainable indicator *SRI* equals 1 for sustainable investments (treatment group), and 0 for traditional investments (control group). The post-treatment dummy *CP* equals 1 after the announcement of the climate policy, and 0 otherwise. The dependent variables are *AUM growth*, the growth of asset under management (AUM) in an economy, *Flow*, the dollar amount of capital flow as a ratio of AUM, and *Return*, the investment returns. Columns 1-3 control for asset-economy (as opposed to sustainability-asset-economy in most regressions), asset-time, and economy-time fixed effects (FE). Columns 4-6 exclude economy-time FE so as to estimate the coefficient of *CP*. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1) *AUM growth*	(2) *Flow*	(3) *Return*	(4) *AUM growth*	(5) *Flow*	(6) *Return*
$SRI \times CP$	0.050***	0.028***	0.022***	0.072***	0.039***	0.033***
	(0.011)	(0.010)	(0.006)	(0.012)	(0.010)	(0.006)
SRI	0.169***	0.197***	-0.028***	0.142***	0.185***	-0.042***
	(0.008)	(0.006)	(0.004)	(0.008)	(0.006)	(0.004)
CP				-0.008	-0.008	0.000
				(0.014)	(0.011)	(0.008)
Observations	276,961	276,961	276,961	286,561	286,561	286,561
R-squared	0.775	0.409	0.912	0.662	0.223	0.840
Asset×economy FE	Yes	Yes	Yes	Yes	Yes	Yes
Asset×time FE	Yes	Yes	Yes	Yes	Yes	Yes
Economy×time FE	Yes	Yes	Yes	No	No	No

Appendix

Appendix Table 1. List of economies adopting climate policies

This table list the economies that have announced to implement either emission trading system (ETS) or carbon tax to regulate carbon emissions. The economies that have announced but not yet implemented either ETS or carbon tax is marked in *Italic* and red. The economies that have only implemented the climate policy at subnational level is highlighted in **bold**.

ETS only		**Both ETS & carbon tax**		**Carbon tax only**
Australia	Kazakhstan	Canada	Netherlands	Argentina
Austria	Lithuania	*Chile*	Poland	Norway
Belgium	New Zealand	*Colombia*	Portugal	Singapore
Bulgaria	*Pakistan*	Denmark	Slovenia	South Africa
China	Romania	Estonia	Spain	
Croatia	*Russia*	Finland	Sweden	
Cyprus	*Serbia*	France	Switzerland	
Czech Republic	South Korea	Ireland	**United States**	
Germany	*Taiwan*	**Japan**	Ukraine	
Greece	*Thailand*	**Mexico**	United Kingdom	
Hungary	*Turkey*			
Indonesia	*Vietnam*			
Italy				

Appendix Table 2. Risk of sustainable and traditional investments before and after climate policy

This table summarizes the mean and standard deviation (SD) of sustainable (treatment group) and traditional (control group) investments, and their difference. *AUM growth volatility* is the standard deviation of the growth of asset under management (AUM) in an economy in the past year (52 weeks). *Flow volatility* is the standard deviation of ratio of the dollar amount of capital flow to AUM in the past year. *Return* is the standard deviation of the investment returns in the past year. *Before* and *After* refer to the periods before and after the announcement of the climate policy, respectively. *DID* is the difference between sustainable and traditional investments after the climate policy's introduction, relative to that before the climate policy. All statistics are in percentage points.

	(1)	(2)	(3)	(4)	(5)	(6)
	Sustainable		Traditional		Sustainable – Traditional	
	Mean	SD	Mean	SD	Difference	p-value
AUM growth volatility						
Before	2.836	0.005	2.024	0.004	0.811	0.000
After	2.340	0.005	1.899	0.005	0.441	0.000
DID					-0.370	0.000
Flow volatility						
Before	1.610	0.004	0.590	0.003	1.021	0.000
After	1.084	0.004	0.369	0.004	0.715	0.000
DID					-0.306	0.000
Return volatility						
Before	1.988	0.004	1.739	0.004	0.249	0.000
After	1.792	0.005	1.756	0.004	0.035	0.000
DID					-0.214	0.000

Appendix Table 3. Impacts of climate policy on sustainable investment risks

This table reports the estimated impact of climate policy on sustainable investment risks. The sustainable indicator *SRI* equals 1 for sustainable investments (treatment group), and 0 for traditional investments (control group). The post-treatment dummy *CP* equals 1 after the announcement of the climate policy, and 0 otherwise. The post-implementation dummy variable CP^{Imp} equals 1 after the implementation of the climate policy, and 0 otherwise. The dependent variable *AUM growth volatility* is the standard deviation of the growth of asset under management (AUM) in an economy in the past year (52 weeks); *Flow volatility* is the standard deviation of ratio of the dollar amount of capital flow to AUM in the past year; and *Return volatility* is the standard deviation of the investment returns in the past year. All regressions control for sustainability-asset-economy, asset-time, and economy-time fixed effects. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1) *Asset growth volatility*	(2) *Flow volatility*	(3) *Return volatility*
$SRI \times CP$	-0.248***	-0.295***	-0.262***
	(0.082)	(0.084)	(0.039)
Constant	2.291***	0.952***	1.848***
	(0.017)	(0.017)	(0.008)
Observations	276,625	276,625	276,625
R-squared	0.805	0.650	0.929

Appendix Table 4. Additional results on the pecuniary channel.

This summarizes how sustainable *AUM growth* and *Return* respond to climate policy associated with different levels of financial returns and risks. The dependent variables are *AUM growth*, the growth of asset under management (AUM), in columns 1–3, and *Return*, the investment returns of existing AUM, in columns 4–6. The sustainable indicator *SRI* equals 1 for sustainable investments (treatment group), and 0 for traditional investments (control group). The post-treatment dummy *CP* equals 1 after the announcement of the climate policy, and 0 otherwise. The dummy D^{Return} equals 1 when the difference between sustainable and traditional investment returns after the climate policy, relative to its pre-policy level, is above the sample median, and 0 otherwise. Similarly, the dummy D^{Risk} equals 1 when the difference between sustainable and traditional investment return volatility after the climate policy's introduction, relative to its pre-policy level, is below the sample median. All regressions control for sustainability-asset-economy, asset-time, and economy-time fixed effects. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	AUM growth	*AUM growth*	*AUM growth*	*Return*	*Return*	*Return*
$SRI \times CP$	0.399***	0.591***	0.480***	0.026	0.145***	0.048**
	(0.045)	(0.041)	(0.039)	(0.019)	(0.011)	(0.019)
$SRI \times CP \times D^{Return}$	0.214***		0.206***	0.182***		0.180***
	(0.041)		(0.040)	(0.034)		(0.034)
$SRI \times CP \times D^{Risk}$		-0.143***	-0.127***		-0.049***	-0.035***
		(0.028)	(0.026)		(0.007)	(0.006)
Observations	276,961	276,961	276,961	276,961	276,961	276,961
R-squared	0.776	0.776	0.777	0.913	0.912	0.913

Appendix Table 5. Additional results on the nonpecuniary channel

This summarizes how sustainable *AUM growth* and *Return* respond to climate policy associated with different levels of climate mitigation and adaptation. The dependent variables are *AUM growth*, the growth of asset under management (AUM), in columns 1–3, and *Return*, the investment returns of existing AUM, in columns 4–6. The sustainable indicator *SRI* equals 1 for sustainable investments (treatment group), and 0 for traditional investments (control group). The post-treatment dummy *CP* equals 1 after the announcement of the climate policy, and 0 otherwise. The dummy variables D^{Carbon}, $D^{Renewable}$ and $D^{Technology}$ equal 1, respectively, when the reduction of carbon emissions, the improvements of renewable energy generation and green technology innovations after the climate policy's introduction, relative to their pre-policy levels, are above the sample median, and 0 otherwise. All regressions control for sustainability-asset-economy, asset-time, and economy-time fixed effects. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	AUM growth	*AUM growth*	*AUM growth*	*Return*	*Return*	*Return*
$SRI \times CP$	0.468***	0.475***	0.499***	0.108***	0.105***	0.116***
	(0.056)	(0.057)	(0.052)	(0.010)	(0.009)	(0.010)
$SRI \times CP \times D^{Carbon}$	0.155***			0.049***		
	(0.042)			(0.009)		
$SRI \times CP \times D^{Renewable}$		0.132***			0.059***	
		(0.039)			(0.009)	
$SRI \times CP \times D^{Technology}$			0.160***			0.068***
			(0.044)			(0.013)
Observations	245,950	245,950	245,950	245,950	245,950	245,950
R-squared	0.775	0.775	0.775	0.911	0.911	0.911

Appendix Table 6. Climate policy before Paris agreement

This table reports the estimated treatment effects of climate policy announced before the 2015 Paris agreement on sustainable investments. The sustainable indicator *SRI* equals 1 for sustainable investments (treatment group) and 0 for traditional investments (control group). The post-treatment dummy *CP* equals 1 after the announcement of the climate policy, and 0 otherwise. The dependent variable *AUM growth* is the growth of asset under management (AUM) in an economy, *Flow* is the capital flows normalized by corresponding AUM, and *Return* is the investment returns. All regressions control for sustainability-asset-economy, asset-time, and economy-time fixed effects. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)
	Climate policy before 2015		
	AUM growth	*Flow*	*Return*
$SRI \times CP$	0.462***	0.332***	0.130***
	(0.056)	(0.048)	(0.012)
Constant	0.016	-0.018	0.034***
	(0.022)	(0.019)	(0.005)
Observations	133,100	133,100	133,100
R-squared	0.816	0.388	0.934

Appendix Table 7. Alternative specifications

This table reports the impact of climate policy on sustainable investment using alternative specifications of fixed effects (FE). The sustainable indicator *SRI* equals 1 for sustainable investments (treatment group), and 0 for traditional investments (control group). The post-treatment dummy *CP* equals 1 after the announcement of the climate policy, and 0 otherwise. The dependent variables are *AUM growth*, the growth of asset under management (AUM) in an economy, *Flow*, the dollar amount of capital flow as a ratio of AUM, and *Return*, the investment returns of existing AUM. Columns 1–3 control for sustainability-class-economy and class-economy-week fixed effects (FE), columns 4–6 control for sustainability-class-economy and class-economy-month FE, columns 7–9 control for only sustainability-class-economy and economy-week, columns 10–12 control for only sustainability-class-economy and week FE. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	AUM growth	*Flow*	*Return*	*AUM growth*	*Flow*	*Return*	*AUM growth*	*Flow*	*Return*	*AUM growth*	*Flow*	*Return*
$SRI \times CP$	0.507***	0.398***	0.109***	0.502***	0.388***	0.115***	0.481***	0.389***	0.092***	0.359***	0.266***	0.093***
	(0.045)	(0.040)	(0.011)	(0.046)	(0.041)	(0.010)	(0.046)	(0.041)	(0.010)	(0.030)	(0.027)	(0.011)
Observations	0.507***	0.398***	0.109***	286,533	286,533	286,533	276,995	276,995	276,995	286,595	286,595	286,595
R-squared	(0.045)	(0.040)	(0.011)	0.259	0.160	0.263	0.627	0.338	0.722	0.508	0.143	0.643
SRI×class×economy FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Class×Economy×week FE	Y	Y	Y	N	N	N	N	N	N	N	N	N
Class×week FE	N	N	N	N	N	N	N	N	N	N	N	N
Economy×week FE	N	N	N	N	N	N	Y	Y	Y	N	N	N
Class×month FE	N	N	N	Y	Y	Y	N	N	N	N	N	N
Economy×month FE	N	N	N	Y	Y	Y	N	N	N	N	N	N
Week FE	N	N	N	N	N	N	N	N	N	Y	Y	Y

Appendix Table 8. Sustainable investments in equity and bond markets.

This table reports the estimated impact of climate policy on sustainable equity and bond investments. The sustainable indicator SRI equals 1 for sustainable investments (treatment group), and 0 for traditional investments (control group). The post-treatment dummy CP equals 1 after the announcement of the climate policy, and 0 otherwise. The dependent variables are *AUM growth*, the growth of asset under management (AUM) in an economy, *Flow*, the dollar amount of capital flow as a ratio of AUM, and *Return*, the investment returns of existing AUM. Columns 1–3 are based on the equity market, while columns 4–6 are based on the bond market. All regressions control for sustainability-asset-economy, asset-time, and economy-time fixed effects. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Equity			**Bond**		
	AUM growth	*Flow*	*Return*	*AUM growth*	*Flow*	*Return*
$SRI \times CP$	0.486***	0.331***	0.156***	0.544***	0.527***	0.017**
	(0.039)	(0.027)	(0.017)	(0.082)	(0.079)	(0.007)
Observations	136,706	136,706	136,706	122,818	122,818	122,818
R-squared	0.902	0.517	0.952	0.672	0.517	0.889

Appendix Table 9. Separate evaluations of sustainable and traditional investments

This table reports the difference in sustainable and traditional investments between post- and pre-policy periods in the left and right panels respectively. The climate dummy *CP* equals 1 after the announcement of the climate policy, and 0 otherwise. The dependent variables are *AUM growth*, the growth of asset under management (AUM) in an economy, *Flow*, the dollar amount of capital flow as a ratio of AUM, and *Return*, the investment returns of existing AUM. Columns 1–3 are based on the sample of sustainable investments, while columns 4–6 are based on the sample of traditional investments. All regressions control for asset-economy and asset-time fixed effects. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Sustainable investments			**Traditional investments**		
	AUM growth	*Flow*	*Return*	*AUM growth*	*Flow*	*Return*
$SRI \times CP$	0.049**	0.047**	0.002	-0.018	-0.028	0.010
	(0.020)	(0.020)	(0.006)	(0.032)	(0.018)	(0.018)
Observations	129,749	129,749	129,749	156,799	156,799	156,799
R-squared	0.726	0.474	0.891	0.763	0.232	0.849

Appendix Table 10. Additional control variables

This table reports the estimated impact of climate policy on sustainable investments, controlling for additional variables. The sustainable indicator SRI equals 1 for sustainable investments (treatment group), and 0 for traditional investments (control group). The post-treatment dummy CP equals 1 after the announcement of the climate policy, and 0 otherwise. The dependent variables are *AUM growth*, the growth of asset under management (AUM) in an economy, *Flow*, the dollar amount of capital flow as a ratio of AUM, and *Return*, the investment returns of existing AUM. *Flow volatility* and *Return volatility* are the standard deviation of *Flow* and *Return* in the past year. We control for one-week lagged *Flow* and *Return* as well as their volatilities. All regressions control for sustainability-asset-economy, asset-time, and economy-time fixed effects. Heterogeneity robust standard error clustered by economy is reported in the parenthesis. ***, **, and * denote the significance level at 1%, 5%, and 10%, respectively.

	(1) *AUM growth*	(2) *Flow*	(3) *Return*
$SRI \times CP$	0.432***	0.311***	0.121***
	(0.042)	(0.038)	(0.012)
$Flow_{a,s,i,t-1}$	0.081***	0.083***	-0.003*
	(0.009)	(0.009)	(0.002)
$Return_{a,s,i,t-1}$	-0.031***	0.052***	-0.082***
	(0.011)	(0.007)	(0.010)
$Flow\ volatility_{a,s,i,t-1}$	-0.039***	-0.028**	-0.011***
	(0.014)	(0.012)	(0.003)
$Return\ volatility_{a,s,i,t-1}$	-0.101***	-0.142***	0.040***
	(0.027)	(0.020)	(0.014)
Observations	258,532	258,532	258,532
R-squared	0.825	0.523	0.942