Online Appendix
to
Pricing Climate Change Exposure

Zacharias Sautner* Laurence van Lent† Grigory Vilkov‡ Ruishen Zhang§

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*__Frankfurt School of Finance & Management and ECGI__; Postal Address: Adickesallee 32-34, 60322 Frankfurt am Main, Germany; E-mail: z.sautner@fs.de.

†__Frankfurt School of Finance & Management__; Postal Address: Adickesallee 32-34, 60322 Frankfurt am Main, Germany; E-mail: l.vanlent@fs.de.

‡__Frankfurt School of Finance & Management__; Postal Address: Adickesallee 32-34, 60322 Frankfurt am Main, Germany; E-mail: vilkov@vilkov.net.

§__Institute of Accounting and Finance, Shanghai University of Finance and Economics__; Postal Address: Guoding Road 777, 200433, Shanghai, China; E-mail: zhangruishen@sufe.edu.cn.

Data Appendix: Variable Definitions (repeated from the main paper)

Variable	Years	Definition
		Climate Change Exposure Measures
$CCExposure_{i,t}$	2005-2020	Relative frequency with which bigrams related to climate change occur in quarterly earnings calls. Resampled to a monthly frequency by matching the transcript date to a given stock-month and applying exponential smoothing with a half-life of three months. Source: Sautner et al. (2022).
$CCExposure^{Ind}_{i,t}$	2005-2020	Industry-level component of $CCExposure_{i,t}$, calculated by averaging $CCExposure_{i,t}$ across all stocks in an industry at a point in time (based on two-digit SIC codes).
$CCExposure^{Res}_{i,t}$	2005-2020	Firm-specific component of $CCExposure_{i,t}$. For each stock, calculated as $CCExposure_{i,t}$ - $CCExposure^{Ind}_{i,t}$.
$CCExposure^{Opp}_{i,t}$	2005-2020	Relative frequency with which bigrams that capture opportunities related to climate change occur in quarterly earnings calls. Resampled to a monthly frequency by matching the transcript date to a given stock-month and applying exponential smoothing with a half-life of three months. Source: Sautner et al. (2022).
$CCExposure^{Reg}_{i,t}$	2005-2020	Relative frequency with which bigrams that capture regulatory shocks related to climate change occur in the quarterly earnings calls. Resampled to a monthly frequency by matching the transcript date to a given stock-month and applying exponential smoothing with a half-life of three months. Source: Sautner et al. (2022).
$CCExposure^{Phy}_{i,t}$	2005-2020	Relative frequency with which bigrams that capture physical shocks related to climate change occur in quarterly earnings calls. Resampled to a monthly frequency by matching the transcript date to a given stock-month and applying exponential smoothing with a half-life of three months. Source: Sautner et al. (2022).
$CCSentiment^{Ltg}_{i,t}$	2005-2020	Relative frequency with which bigrams related to climate change litigation are mentioned in quarterly earnings conference calls. Resampled to a monthly frequency by matching the transcript date to a given stock-month and applying exponential smoothing with a half-life of three months. Source: Self-constructed.
$CCSentiment^{Neg}_{i,t}$	2005-2020	Relative frequency with which bigrams related to climate change are mentioned together with the negative tone words that are summarized by Loughran and McDonald (2011) in one sentence in quarterly earnings calls. Resampled to a monthly frequency by matching the transcript date to a given stock-month and applying exponential smoothing with a half-life of three months. Source: Sautner et al. (2022).
		Expected Excess Return Proxies
$RET_{i,t}$	2005-2020	Next-month realized returns minus the one-month T-bill rate for the corresponding period. Winsorized at 1% and 99%. Source: CRSP.
$MW_{i,t}$	2005-2020	Expected excess return proxy proposed by Martin and Wagner (2019) (MW). Derived as lower bounds for the conditional expected excess return from out-the-money options. Winsorized at 1% and 99%. Source: Vilkov (2020) based on Volatility Surface File of Ivy DB OptionMetrics.
$GLB_{i,t}$	2005-2020	Expected excess return proxy proposed by Chabi-Yo et al. (2022) (GLB). Derived as the generalized lower bounds for the conditional expected excess return from out-the-money options. Winsorized at 1% and 99%. Source: Chabi-Yo et al. (2022) based on Volatility Surface File of Ivy DB OptionMetrics.
		Betas for Factor Models
$Market_{i,t}$	2005-2020	Market beta estimated for each month using daily excess returns and factor realizations over the past 12 months. Source: K. French's DataLibrary.
$Size\ (SMB)_{i,t}$	2005-2020	Size factor beta estimated for each month using daily excess returns and factor realizations over the past 12 months. Source: K. French's DataLibrary.
$Value\ (HML)_{i,t}$	2005-2020	Value factor beta estimated for each month using daily excess returns and factor realizations over the past 12 months. Source: K. French's DataLibrary.
$Momentum\ (WML)_{i,t}$	2005-2020	Momentum factor beta estimated for each month using daily excess returns and factor realizations over the past 12 months. Source: K. French's DataLibrary.
$Profitability\ (RMW)_{i,t}$	2005-2020	Profitability factor beta estimated for each month using daily excess returns and factor realizations over the past 12 months. Source: K. French's DataLibrary.
$Investment\ (CMA)_{i,t}$	2005-2020	Investment factor beta estimated for each month using daily excess returns and factor realizations over the past 12 months. Source: K. French's DataLibrary.

Variable	Years	Definition
		Risk Quantities
$IV_{i,t}$	2005-2020	Implied variance calculated as the Martin (2017) variance swap rate from 30-day out-the-money options. Source: Volatility Surface File of Ivy DB OptionMetrics.
$ISkew_{i,t}$	2005-2020	Implied skewness of log returns computed from 30-day out-the-money options following Bakshi et al. (2003). Winsorized at 1% and 99%. Source: Vilkov (2020) based on Volatility Surface File of Ivy DB OptionMetrics.
$IKurt_{i,t}$	2005-2020	Implied kurtosis of log returns computed from 30-day out-the-money options following Bakshi et al. (2003). Winsorized at 1% and 99%. Source: Vilkov (2020) based on Volatility Surface File of Ivy DB OptionMetrics.
$SlopeD_{i,t}$	2005-2020	Steepness of the implied volatility slope on the left from the at-the-money (ATM) point. As in Kelly et al. (2016), the measure is the slope of functions relating implied volatilities of OTM options to their deltas. We estimate *SlopeD* by regressing implied volatilities of puts with deltas between -0.1 and -0.5 on their deltas (and a constant). Winsorized at 1% and 99%. Source: Vilkov (2020) based on Volatility Surface File of Ivy DB OptionMetrics.
$SlopeU_{i,t}$	2005-2020	Steepness of the implied volatility slope on the right from the at-the-money (ATM) point. Similar to *SlopeD*, the measures is the slope of functions relating implied volatilities of OTM options to their deltas. We estimate $SlopeU_{i,t}$ by regressing implied volatilities of calls with deltas between 0.1 and 0.5 on their deltas. We multiply the resulting number by minus one and take the resulting slope coefficient as the *SlopeU* measure. Winsorized at 1% and 99%. Source: Vilkov (2020) based on Volatility Surface File of Ivy DB OptionMetrics.
		Fundamentals and Market Characteristics
$Market\ Cap_{i,t}$	2005-2020	A stock's market capitalization. Source: CRSP.
$Assets_{i,t}$	2005-2020	Total assets (Compustat item AT). Winsorized at 1% and 99%. Source: Compustat NA Annual.
$Debt/Assets_{i,t}$	2005-2020	Sum of the book value of long-term debt (Compustat data item DLTT) and the book value of current liabilities (DLC) divided by total assets (Compustat data item AT). Winsorized at 1% and 99%. Source: Compustat NA Annual.
$Cash/Assets_{i,t}$	2005-2020	Cash and short-term investments (Compustat data item CHE) divided by total assets (Compustat data item AT). Winsorized at 1% and 99%. Source: Compustat NA Annual.
$PP\&E/Assets_{i,t}$	2005-2020	Property, plant, and equipment (Compustat data item PPENT) divided by total assets (Compustat data item AT). Winsorized at 1% and 99%. Source: Compustat NA Annual.
$EBIT/Assets_{i,t}$	2005-2020	Earnings before interest and taxes (Compustat data item EBIT) divided by total assets (Compustat data item AT). Winsorized at 1% and 99%. Source: Compustat NA Annual.
$Capex/Assets_{i,t}$	2005-2020	Capital expenditures divided by assets. Winsorized at 1% and 99%. Source: Compustat NA Annual.
$R\&D/Assets_{i,t}$	2005-2020	R&D expenditures (Compustat data item XRD) divided by total assets (Compustat data item AT). Missing values set to zero. Winsorized at 1% and 99%. Source: Compustat NA Annual.
$Volatility_{i,t}$	2005-2020	Annualized volatility of stock i from daily returns from month $t-12$ to t. Winsorized at 1% and 99%. Source: CRSP.
$Momentum12_{i,t}$	2005-2020	Cumulative return of stock i from $t-13$ to $t-1$ estimated at the end of month t. Winsorized at 1% and 99%. Source: CRSP.
		CO_2, Oil Exposure, and Carbon Risk Measures
$Carbon\ Emissions_{i,t}$	2005-2020	Sum of Scope 1 and Scope 2 emissions. We follow Bolton and Kacperczyk (2021a,b) in using emission levels. Scope 1 emissions are caused by the combustion of fossil fuels or from the release during manufacturing. Scope 2 emissions originate from the purchase of electricity, heating, or cooling. As this variable is available at the annual frequency, we use the emissions data from year $t-1$ for all months in year t. Winsorized at 1% and 99%. Source: S&P Global Trucost.
$ISS\ Score_{i,t}$	2015-2019	Carbon Risk Rating of ISS, assesses the carbon-related performance of firms and takes values between 1 (poor performance) and 4 (excellent performance). As this variable is available at the annual frequency, we merge with monthly returns data by stock-year for all months in a given year t. Source: ISS (part of Deutche Börse).

Variable	Years	Definition
		CO_2, Oil Exposure, and Carbon Risk Measures
$Sustainalytics\ Score_{i,t}$	2013-2020	Carbon Risk Rating of Sustainalytics, with a focus on firms' exposures and management of material carbon risks. As this variable is available at the variable frequency, we merge with monthly returns data by stock-month and fill forward for up to 12 months. Source: Sustainalytics (part of Morningstar).
$Oil\ Beta_{i,t}$	2005-2020	Oil beta of the stock, estimated using daily excess returns and oil price (WTI spot) percentage changes over the past 12 months (jointly with the 6-factor model). Source: U.S. Energy Information Administration.
		Institutional and Market Factors
$Green\ Innovation_t$	2005-2020	Monthly total number of green patents filed in the U.S. in the previous three years according to the Google Patents database. To identify "green" patents, we follow the approach in Cohen et al. (2021) and apply the OECD classification to identify what constitutes a patent with the potential to address environmental problems. As this variable is available at the annual frequency, we propagate the same value for all observations in a given year. Source: Google Patents.
$Adaptation_t$	2005-2020	Monthly measure of the proportion of climate change exposure in the S&P 500 coming from states with adaptation plans. In a first step, we create the firm-level variable $\mathbf{1}^{Adapted\ State}$, which equals one from a particular date if the firm's headquarters are located in a state adopting state-led climate change adaptation plans. Stocks are matched to states based on their headquarters location. In a second step, we construct monthly values of $Adaptation_t$ by weighting $CCExposure$ with $\mathbf{1}^{Adapted\ State}$: $$Adaptation_t = \frac{\sum_i \mathbf{1}^{Adapted\ State}_{i,t} \times CCExposure_{i,t}}{\sum_i CCExposure_{i,t}}.$$ Source: Georgetown Climate Center.
$ESG\ Fund\ Flows_t$	2005-2020	Monthly net flow into ESG funds. We first obtain the list of sustainable funds from Morningstar's 2021 Sustainable Funds U.S. Landscape Report (Pastor et al. 2021), which contains funds tickers, inception dates, and repurpose dates (when a fund was repurposed as "sustainable"). We then match these sustainable funds with the CRSP Survivor-Bias-Free U.S. Mutual Funds by their tickers and inception dates. For funds that reposition themselves as sustainable funds, we use their "repurposed date" to match with the CRSP database. We calculate the net fund flows as the change in total net assets (TNA) minus appreciation (computed using reported fund's return $R_{j,t}$) during the month. We then aggregate this measure across all funds j in month t. Source: Morningstar's 2021 Sustainable Funds U.S. Landscape Report, CRSP Survivor-Bias-Free U.S. Mutual Funds.
$Big\ Three\ IO_t$	2005-2017	Monthly climate change exposure of the Big Three (Vanguard, BlackRock, and StateStreet) in the S&P 500 relative to the climate change exposure held in the market. Computed each month t as the $CCExposure_{i,t}$-weighted holdings by the Big Three in S&P 500 stocks. First, we obtain data on Big Three holdings ($Big\ Three_{i,t}$) by using the quarterly stock ownership data from Schedule 13F filings compiled by Backus et al. (2021). The data has better coverage than Thomson Reuters. We follow Ben-David et al. (2021) and use the following Thomson-Reuters mgrno to identify Big Three holdings: Vanguard (90457), StateStreet (81540), BlackRock (9385, 11386, 39539, 56790, 91430, and 12588). Holdings are matched with monthly data by the end of the quarter and propagated forward using exponential smoothing (half-life of 3 months). Second, to obtain $CCExposure_{i,t}$-weighted holdings each month, we multiply the Big Three's percentage holdings $Big\ Three_{i,t}$ in stock i at time t by $CCExposure_{i,t}$, sum the product across stocks, and divide the total by the sum of $CCExposure_{i,t}$: $$Big\ Three\ IO_t = \frac{\sum_i Big\ Three_{i,t} \times CCExposure_{i,t}}{\sum_i CCExposure_{i,t}}.$$ Available from 01/2005 to 12/2017. Source: Backus et al. (2021).
$Oil\ Price_t$	2005-2020	Monthly WTI spot price, created as the average of daily WTI spot price prices. Source: U.S. Energy Information Administration.
$CO_2\ Price_t$	2005-2020	Monthly futures price of CO_2 emission allowances. Available from 08/2005 to 12/2020 based on front-month data. Source: EU Emission Trading System.

Bigram	Frequency	Bigram	Frequency	Bigram	Frequency
renewable energy	15605	onshore wind	878	carbon intensity	641
electric vehicle	9508	electric motor	869	energy application	615
clean energy	6430	provide energy	851	produce electricity	604
new energy	4544	efficient solution	839	help state	604
climate change	4374	global warm	837	environmental standard	593
wind power	4253	power generator	828	power agreement	586
wind energy	4035	solar pv	827	supply energy	585
energy efficient	3899	scale solar	827	electric hybrid	585
greenhouse gas	3416	need clean	821	source power	575
solar energy	2511	coastal area	816	sustainability goal	572
air quality	2409	energy star	793	energy reform	571
clean air	2301	environmental footprint	792	plant power	564
carbon emission	2088	design use	777	compare conventional	560
gas emission	1910	area energy	777	gas vehicle	560
extreme weather	1773	charge station	762	effort energy	560
carbon dioxide	1583	clean water	759	pass house	559
water resource	1423	major design	747	carbon free	558
autonomous vehicle	1394	vehicle manufacturer	740	driver assistance	545
energy environment	1279	future energy	737	electrical energy	543
wind resource	1245	motor control	726	solar installation	541
government india	1201	combine heat	718	snow ice	538
battery power	1147	electric bus	709	renewable natural	536
air pollution	1127	distribute power	703	promote use	536
battery electric	1121	environmental benefit	695	farm project	531
integrate resource	1052	eco friendly	695	laser diode	528
clean power	1008	electrical vehicle	695	deliver energy	526
carbon price	999	carbon neutral	690	protect environment	525
world population	977	fast charge	675	sustainable energy	523
solar farm	971	cell power	657	manage energy	522
energy regulatory	967	energy team	650	invest energy	521
obama administration	957	cycle gas	646	electric energy	519
heat power	941	coal gasification	643	forest land	512
carbon tax	928	environmental concern	643	capacity energy	512
unite nation	925				

OA Table 1: Top-100 Bigrams Captured by Climate Change Exposure (*CCExposure*). This table reports the top-100 bigrams associated with *CCExposure*, which measures the relative frequency with which bigrams related to climate change occur in the transcripts of earnings calls. The bigrams are based on the global sample that includes 86,152 firm-year observations from 10,673 firms headquartered in 34 countries (see Sautner et al. (2022) for details).

	$CCE_{i,t}$	$CCE^{Opp}_{i,t}$	$CCE^{Reg}_{i,t}$	$CCE^{Phy}_{i,t}$	$RET_{i,t}$	$MW_{i,t}$	$GLB_{i,t}$
Panel A: Climate Change Exposure Measures							
$CCExposure_{i,t}$	1.000	0.913	0.725	0.111	-0.002	-0.026	-0.000
$CCExposure^{Ind}_{i,t}$	0.721	0.647	0.541	0.095	-0.005	-0.040	-0.007
$CCExposure^{Res}_{i,t}$	0.693	0.645	0.483	0.062	0.002	0.003	0.006
$CCExposure^{Opp}_{i,t}$	0.913	1.000	0.578	0.051	0.000	-0.013	0.000
$CCExposure^{Reg}_{i,t}$	0.725	0.578	1.000	0.082	-0.005	-0.020	0.012
$CCExposure^{Phy}_{i,t}$	0.111	0.051	0.082	1.000	-0.004	-0.018	-0.009
$CCExposure^{Ltg}_{i,t}$	0.153	0.135	0.142	0.008	0.001	-0.009	-0.005
$CCSentiment^{Neg}_{i,t}$	0.817	0.720	0.600	0.130	-0.002	-0.006	0.015
Panel B: Expected Excess Return Proxies							
$RET_{i,t}$, (p.a.)	-0.002	0.000	-0.005	-0.004	1.000	0.049	0.069
$MW_{i,t}$, (p.a.)	-0.026	-0.013	-0.020	-0.018	0.049	1.000	0.791
$GLB_{i,t}$, (p.a.)	-0.000	0.000	0.012	-0.009	0.069	0.791	1.000
Panel C: Betas for Factor Models							
$Market_{i,t}$	-0.118	-0.105	-0.098	-0.014	0.000	0.220	0.132
$Size\ (SMB)_{i,t}$	-0.102	-0.082	-0.105	-0.006	0.031	0.324	0.150
$Value\ (HML)_{i,t}$	-0.002	-0.016	0.018	0.014	0.001	0.092	0.099
$Momentum\ (WML)_{i,t}$	0.038	0.025	0.033	0.011	0.015	-0.215	-0.103
$Profitability\ (RMW)_{i,t}$	0.049	0.031	0.044	0.013	0.016	-0.072	0.001
$Investment\ (CMA)_{i,t}$	0.063	0.059	0.046	0.015	-0.023	-0.117	-0.107
Panel D: Risk Quantities							
$IV_{i,t}$	-0.028	-0.014	-0.021	-0.018	-0.086	0.903	0.684
$ISkew_{i,t}$	-0.057	-0.052	-0.039	-0.012	-0.122	0.121	-0.052
$IKurt_{i,t}$	0.154	0.142	0.101	0.028	0.037	-0.192	-0.074
$SlopeU_{i,t}$	0.120	0.115	0.075	0.022	-0.042	-0.011	0.003
$SlopeD_{i,t}$	0.095	0.094	0.059	0.015	0.025	0.217	0.313
Panel E: Fundamentals and Market Characteristics							
$Log(Market\ Cap)_{i,t}$	0.007	0.008	0.036	-0.015	-0.031	-0.321	-0.137
$Log(Assets)$	0.096	0.082	0.112	0.005	-0.027	-0.170	-0.062
$Debt/Assets_{i,t}$	0.080	0.067	0.065	0.025	0.001	0.044	0.005
$Cash/Assets_{i,t}$	-0.152	-0.113	-0.131	-0.060	0.020	0.070	-0.017
$PP\&E/Assets_{i,t}$	0.365	0.300	0.294	0.058	-0.005	0.014	-0.030
$EBIT/Assets_{i,t}$	-0.106	-0.095	-0.086	-0.020	-0.004	-0.195	-0.065
$Capex/Assets_{i,t}$	0.157	0.137	0.117	-0.004	0.000	0.056	-0.007
$R\&D/Assets_{i,t}$	-0.088	-0.054	-0.087	-0.053	0.021	0.073	0.001
$Volatility_{i,t}$	-0.083	-0.058	-0.072	-0.040	0.064	0.630	0.396
$Momentum12_{i,t}$	-0.006	-0.005	-0.019	0.001	-0.002	-0.251	-0.316
Panel F: CO_2 and Oil Exposure Measures							
$Log(Carbon\ Emissions)_{i,t}$	0.401	0.341	0.335	0.025	-0.021	-0.124	-0.095
$Oil\ Beta_{i,t}$	0.039	0.023	0.034	0.002	-0.007	0.044	0.011

OA Table 2: Correlations to Climate Exposure Measures.
This table reports unconditional correlations between selected variables at the stock-month level. The sample covers the period from 01/2005 to 12/2020 and includes S&P 500 stocks.

Expected Excess Return	$RET_{i,t}$			$MW_{i,t}$			$GLB_{i,t}$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Market_{i,t}$	-0.025	-0.005	-0.001	-0.001	0.008	0.009	0.033	0.037	0.037
	(-0.382)	(-0.069)	(-0.018)	(-0.399)	(2.863)	(3.295)	(6.790)	(8.366)	(8.373)
$Size\ (SMB)_{i,t}$	0.014	-0.009	-0.002	0.019	0.015	0.015	-0.001	0.000	0.001
	(0.491)	(-0.344)	(-0.066)	(10.510)	(6.761)	(6.701)	(-0.633)	(0.188)	(0.211)
$Value\ (HML)_{i,t}$	-0.021	-0.025	-0.022	-0.007	-0.011	-0.010	0.001	-0.001	-0.001
	(-0.509)	(-0.545)	(-0.499)	(-4.407)	(-6.802)	(-6.371)	(0.563)	(-0.372)	(-0.408)
$Momentum\ (WML)_{i,t}$	-0.018	-0.010	-0.015	-0.008	-0.006	-0.007	-0.001	0.000	0.000
	(-0.349)	(-0.196)	(-0.299)	(-1.770)	(-1.709)	(-1.835)	(-0.169)	(0.090)	(0.037)
$Profitability\ (RMW)_{i,t}$	0.018	0.023	0.021	-0.004	-0.004	-0.004	-0.005	-0.004	-0.004
	(0.748)	(1.064)	(0.972)	(-3.687)	(-3.698)	(-3.785)	(-5.571)	(-5.924)	(-5.951)
$Investment\ (CMA)_{i,t}$	-0.035	-0.033	-0.033	-0.002	-0.004	-0.003	-0.006	-0.005	-0.005
	(-1.333)	(-1.250)	(-1.256)	(-1.532)	(-2.098)	(-2.033)	(-4.907)	(-3.792)	(-3.766)
$CCExposure_{i,t}$	1.183	–	0.928	0.105	–	0.119	-0.037	–	0.011
	(1.556)	–	(1.337)	(1.998)	–	(2.901)	(-1.212)	–	(0.427)
$ISS\ Score_{i,t}$	–	0.815	0.801	–	0.018	0.016	–	-0.034	-0.034
	–	(1.080)	(1.069)	–	(0.321)	(0.296)	–	(-1.126)	(-1.144)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample Period	01/2015-12/2019								
Obs.	29044	26040	26040	28969	26039	26039	28969	26039	26039
R^2	0.003	0.003	0.003	0.445	0.413	0.414	0.101	0.106	0.106

OA Table 3: Risk Premium for ISS Carbon Risk Rating: Unconditional Evidence for 2015-2019. This table reports results of Fama-MacBeth regressions at the stock-month level for the years from 2015 to 2019. We report the risk premium estimates for the ISS Carbon Risk Rating ($ISS\ Score$) and for firm-specific climate change exposure ($CCExposure$). All climate change exposure risk premiums are in % p.a. after controlling for a 6-factor model (combination of 4- and 5-factor models) (in decimals p.a.) and stock characteristics (described in Section 3.2). As proxies for expected excess returns, we use the realized excess returns (RET), the forward-looking proxy by Martin and Wagner (2019) (MW), and the forward-looking proxy by Chabi-Yo et al. (2022) (GLB). All explanatory variables (except for the factor betas) are normalized at each point in time to have a standard deviation of 0.01. t-statistics based on Newey and West (1987) standard errors with three lags are reported in parentheses. The sample covers the period from 01/2015 to 12/2019 and includes S&P 500 stocks.

Expected Excess Return	$RET_{i,t}$			$MW_{i,t}$			$GLB_{i,t}$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Market_{i,t}$	-0.032	-0.038	-0.039	-0.000	0.006	0.007	0.035	0.034	0.034
	(-0.625)	(-0.716)	(-0.762)	(-0.195)	(2.461)	(2.981)	(6.621)	(6.756)	(7.381)
$Size\ (SMB)_{i,t}$	0.023	0.028	0.032	0.018	0.009	0.009	0.001	0.002	0.003
	(1.011)	(1.410)	(1.629)	(11.086)	(5.643)	(6.167)	(0.569)	(1.428)	(1.589)
$Value\ (HML)_{i,t}$	-0.020	-0.018	-0.016	-0.003	-0.003	-0.002	0.003	0.002	0.003
	(-0.678)	(-0.582)	(-0.509)	(-1.002)	(-0.832)	(-0.712)	(1.163)	(0.768)	(0.943)
$Momentum\ (WML)_{i,t}$	0.004	-0.006	-0.012	-0.010	-0.008	-0.008	-0.002	-0.004	-0.004
	(0.103)	(-0.171)	(-0.332)	(-2.148)	(-1.617)	(-1.645)	(-0.762)	(-0.980)	(-0.979)
$Profitability\ (RMW)_{i,t}$	0.022	0.029	0.028	-0.003	-0.003	-0.004	-0.001	-0.000	-0.000
	(1.125)	(1.638)	(1.593)	(-2.337)	(-3.276)	(-3.414)	(-0.473)	(-0.230)	(-0.201)
$Investment\ (CMA)_{i,t}$	-0.024	-0.020	-0.019	-0.002	-0.004	-0.004	-0.005	-0.005	-0.005
	(-1.384)	(-1.127)	(-1.115)	(-1.811)	(-3.591)	(-3.407)	(-5.487)	(-5.424)	(-5.259)
$CCExposure_{i,t}$	0.932	–	0.309	0.144	–	0.183	0.188	–	0.221
	(1.498)	–	(0.551)	(3.060)	–	(4.280)	(2.185)	–	(2.522)
$Sustainalytics\ Score_{i,t}$	–	-1.196	-1.222	–	-0.182	-0.189	–	-0.049	-0.059
	–	(-1.791)	(-1.807)	–	(-2.790)	(-2.873)	–	(-0.995)	(-1.155)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample Period	01/2013-12/2020								
Obs.	45605	40552	40552	45477	40552	40552	45477	40552	40552
R^2	0.004	0.004	0.004	0.334	0.237	0.235	0.077	0.073	0.071

OA Table 4: Risk Premium for Sustainalytics Carbon Risk Rating: Unconditional Evidence for 2013-2020.

This table reports results of Fama-MacBeth regressions at the stock-month level for the years from 2013 to 2020. We report the risk premiums for the Carbon Risk Rating from Sustainalytics ($SustainalyticsScore$) and for firm-specific climate change exposure ($CCExposure$). All climate change exposure risk premiums are in % p.a. after controlling for a 6-factor model (combination of 4- and 5-factor models) (in decimals p.a.) and stock characteristics (described in Section 3.2). As proxies for expected excess returns, we use the realized excess returns (RET), the forward-looking proxy by Martin and Wagner (2019) (MW), and the forward-looking proxy by Chabi-Yo et al. (2022) (GLB). All explanatory variables (except for the factor betas) are normalized at each point in time to have standard deviations of 0.01. t-statistics based on Newey and West (1987) standard errors with three lags are reported in parentheses. The sample covers the period from 01/2013 to 12/2020 and includes S&P 500 stocks.

Expected Excess Return	$RET_{i,t}$		$MW_{i,t}$		$GLB_{i,t}$	
	(1)	(2)	(3)	(4)	(5)	(6)
$Market_{i,t}$	-0.035	-0.035	0.013	0.013	0.043	0.044
	(-0.987)	(-0.955)	(3.294)	(3.327)	(8.623)	(8.607)
$Size\ (SMB)_{i,t}$	0.028	0.027	0.014	0.014	0.007	0.007
	(1.474)	(1.464)	(10.169)	(10.078)	(4.389)	(4.394)
$Value\ (HML)_{i,t}$	-0.014	-0.015	0.004	0.004	0.005	0.005
	(-0.696)	(-0.747)	(1.785)	(1.780)	(3.245)	(3.256)
$Momentum\ (WML)_{i,t}$	0.010	0.013	-0.013	-0.012	-0.009	-0.009
	(0.382)	(0.493)	(-3.049)	(-3.030)	(-2.342)	(-2.304)
$Profitability\ (RMW)_{i,t}$	0.021	0.021	-0.005	-0.005	-0.003	-0.003
	(1.626)	(1.609)	(-4.640)	(-4.713)	(-1.915)	(-1.975)
$Investment\ (CMA)_{i,t}$	-0.009	-0.009	-0.002	-0.002	-0.002	-0.002
	(-0.779)	(-0.791)	(-2.117)	(-2.078)	(-2.362)	(-2.172)
$CCSentiment^{Neg}_{i,t}$	0.208	–	0.085	–	0.102	–
	(0.485)	–	(2.601)	–	(2.128)	–
$CCSentiment^{Neg,Ind}_{i,t}$	–	-0.046	–	0.049	–	0.106
	–	(-0.074)	–	(1.489)	–	(2.303)
$CCSentiment^{Neg,Res}_{i,t}$	–	0.273	–	0.072	–	0.061
	–	(0.928)	–	(2.693)	–	(1.648)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sample Period	01/2005-12/2020					
Obs.	83114	83114	82653	82653	82653	82653
R^2	0.001	0.001	0.302	0.302	0.067	0.067

OA Table 5: Risk Premium for Negative Climate Change Sentiment: Unconditional Evidence. This table reports the results of Fama-MacBeth regressions at the stock-month level. We report the risk premium estimates for negative climate change sentiment ($CCSentiment^{Neg}$) and for the measure's two components, industry average negative climate change sentiment ($CCSentiment^{Neg,Ind}$) and the residual ($CCSentiment^{Neg,Res}$). All negative climate change sentiment risk premiums are in % p.a. after controlling for a 6-factor model (combination of 4- and 5-factor models) (in decimals p.a.) and stock characteristics (described in Section 3.2). As proxies for expected excess returns, we use the realized excess returns (RET), the forward-looking proxy by Martin and Wagner (2019) (MW), and the forward-looking proxy by Chabi-Yo et al. (2022) (GLB). All explanatory variables (except for the factor betas) are normalized at each point in time to have standard deviations of 0.01. t-statistics based on Newey and West (1987) standard errors with three lags are reported in parentheses. The sample covers the period from 01/2005 to 12/2020 and includes S&P 500 stocks.

Expected Excess Return	$RET_{i,t}$		$MW_{i,t}$		$GLB_{i,t}$	
	(1)	(2)	(3)	(4)	(5)	(6)
$Market_{i,t}$	-0.035	-0.035	0.013	0.014	0.044	0.044
	(-0.967)	(-0.954)	(3.345)	(3.375)	(8.749)	(8.678)
$Size\ (SMB)_{i,t}$	0.029	0.028	0.014	0.014	0.007	0.007
	(1.553)	(1.506)	(10.190)	(10.037)	(4.466)	(4.426)
$Value\ (HML)_{i,t}$	-0.014	-0.015	0.004	0.004	0.005	0.005
	(-0.679)	(-0.729)	(1.808)	(1.801)	(3.279)	(3.271)
$Momentum\ (WML)_{i,t}$	0.009	0.012	-0.013	-0.012	-0.009	-0.009
	(0.335)	(0.447)	(-3.040)	(-3.016)	(-2.318)	(-2.288)
$Profitability\ (RMW)_{i,t}$	0.021	0.020	-0.005	-0.005	-0.003	-0.003
	(1.597)	(1.570)	(-4.685)	(-4.749)	(-1.885)	(-1.960)
$Investment\ (CMA)_{i,t}$	-0.009	-0.009	-0.002	-0.002	-0.002	-0.002
	(-0.749)	(-0.775)	(-2.027)	(-2.047)	(-2.165)	(-2.128)
$Log(1 + CCExposure)_{i,t}$	0.469	–	0.092	–	0.178	–
	(1.004)	–	(2.869)	–	(3.112)	–
$Log(1 + CCExposure)^{Ind}_{i,t}$	–	-0.048	–	0.042	–	0.096
	–	(-0.080)	–	(1.188)	–	(2.127)
$Log(1 + CCExposure)^{Res}_{i,t}$	–	0.578	–	0.081	–	0.145
	–	(1.898)	–	(3.171)	–	(3.462)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sample Period	01/2005-12/2020					
Obs.	83114	83114	82653	82653	82653	82653
R^2	0.001	0.001	0.302	0.302	0.067	0.067

OA Table 6: Risk Premium for the Log of Climate Change Exposure: Unconditional Evidence. This table reports the results of the Fama-MacBeth regressions at the stock-month level. We report the risk premium estimates for the log of the firm-specific climate change exposure ($Log(1 + CCExposure)$) and for the exposure measure's two components, industry average climate change exposure ($Log(1 + CCExposure)^{Ind}$) and the residual ($Log(1 + CCExposure)^{Res}$). All climate change exposure risk premiums are in % p.a. after controlling for a 6-factor model (combination of 4- and 5-factor models) (in decimals p.a.) and stock characteristics (described in Section 3.2). As proxies for expected excess returns, we use the realized excess returns (RET), the forward-looking proxy by Martin and Wagner (2019) (MW), and the forward-looking proxy by Chabi-Yo et al. (2022) (GLB). All explanatory variables (except for the factor betas) are normalized at each point in time to have standard deviations of 0.01. t-statistics based on Newey and West (1987) standard errors with three lags are reported in parentheses. The sample covers the period from 01/2005 to 12/2020 and includes S&P 500 stocks.

Panel A: Overall Variation	$CCExposure_{i,t}$			
	(1)	(2)	(3)	(4)
$CCExposure_{i,t-1}$	0.958	1.030	1.026	0.989
	(238.06)	(170.71)	(165.82)	(220.14)
Model	OLS	IV	IV	IV
Instrument		$CCExposure^{10K}_{i,t-1}$	$CCExposure^{10K}_{i,t-2}$	$CCExposure_{i,t-2}$
Industry x Year Fixed Effects	No	No	No	No
Obs.	9938	9938	9169	9169
Implied Share M.E.		0.070	0.062	0.026
		(0.010)	(0.015)	(0.008)
Panel B: Firm-level Variation	$CCExposure_{i,t}$			
	(1)	(2)	(3)	(4)
$CCExposure_{i,t-1}$	0.896	1.028	1.023	0.951
	(159.57)	(85.34)	(83.64)	(141.86)
Model	OLS	IV	IV	IV
Instrument		$CCExposure^{10K}_{i,t-1}$	$CCExposure^{10K}_{i,t-2}$	$CCExposure_{i,t-2}$
Industry x Year Fixed Effects	Yes	Yes	Yes	Yes
Obs.	9742	9742	8981	8981
Implied Share M.E.		0.128	0.118	0.052
		(0.003)	(0.033)	(0.015)

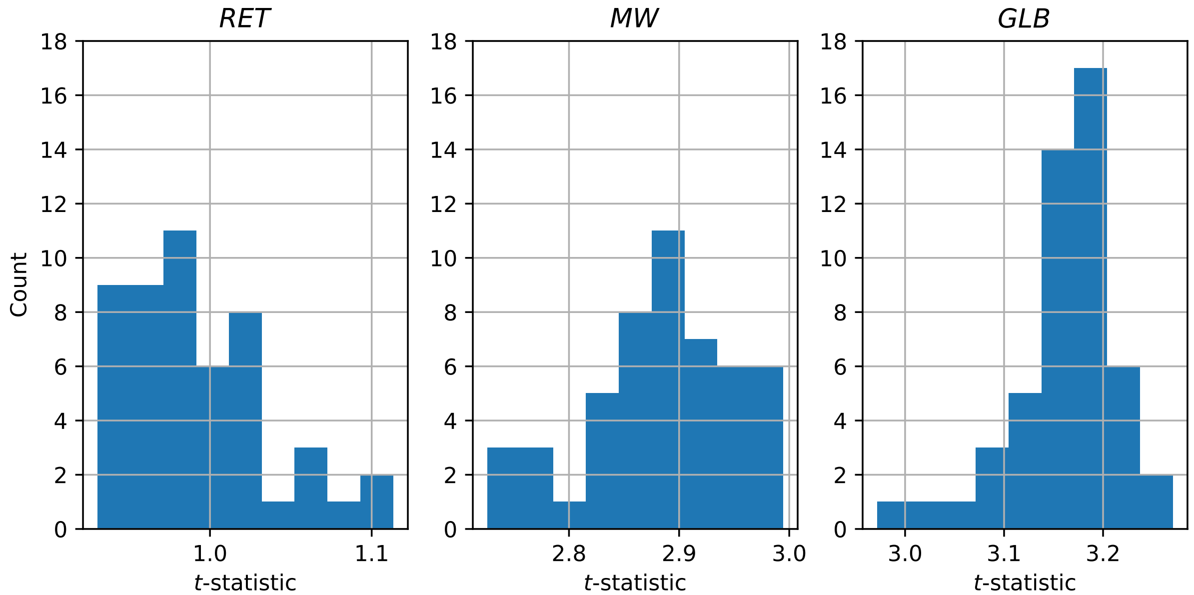
OA Table 7: Measurement Error in Climate Change Exposure
This table quantifies the measurement error in $CCExposure$ in our sample following SvLVZ. The table consists of AR(1) regressions of $CCExposure_{i,t}$ estimated at the annual level. $CCExposure_{i,t}$ is constructed at annual level by averaging the values of the four earnings calls during the year. In this table, we use unsmoothed measures of $CCExposure$. $CCExposure^{10K}$ measures climate change exposure by applying the SvLVZ algorithm to the "Management Discussion and Analysis" (MD&A) section in firms' annual 10K filings. Column (1) reports the OLS estimate of the AR(1) regression $CCExposure_{i,t} = \alpha + \beta CCExposure_{i,t-1} + \epsilon$. In Columns (2) to (4), we estimated the AR(1) regression with different instruments using the same specification. The implied share of the measurement error in Columns 2 to 4 is calculated as $1 - (\hat{\beta}_{OLS}/\hat{\beta}_{IV})$. We standardized the exposure variables by demeaning and dividing by the standard deviation. We report t-statistics for the regression results and bootstrapped standard errors for the estimated implied share of measurement errors. The standard errors of the implied share of measurement error is bootstrapped with 500 repeats.

Expected Excess Return	$RET_{i,t}$	$MW_{i,t}$	$GLB_{i,t}$
	(1)	(2)	(3)
$Market_{i,t}$	-0.031	0.012	0.046
	(-0.710)	(2.411)	(7.728)
$Size\ (SMB)_{i,t}$	0.021	0.015	0.007
	(1.124)	(10.349)	(3.456)
$Value\ (HML)_{i,t}$	-0.011	0.005	0.007
	(-0.453)	(1.699)	(3.373)
$Momentum\ (WML)_{i,t}$	0.003	-0.016	-0.012
	(0.084)	(-3.391)	(-2.598)
$Profitability\ (RMW)_{i,t}$	0.023	-0.006	-0.003
	(1.553)	(-4.285)	(-1.866)
$Investment\ (CMA)_{i,t}$	-0.006	-0.002	-0.002
	(-0.414)	(-1.995)	(-2.331)
$CCExposure_{i,t}^{Ltg}$	0.050	0.022	0.001
	(0.160)	(1.162)	(0.064)
Controls	Yes	Yes	Yes
Sample Period	01/2005-12/2020		
Obs.	69745	69497	69497
R^2	0.001	0.320	0.090

OA Table 8: Risk Premium for Climate Change Litigation Exposure: Unconditional Evidence. This table reports the results of the Fama-MacBeth regressions at the stock-month level. We report the risk premium estimates for firm-specific climate change exposure related to litigation ($CCExposure^{Ltg}$). The litigation keywords used to construct $CCExposure^{Ltg}$ are litigation, lawsuit, legal case, prosecution, indictment, law enforcement, legal investigation, legal action, legal dispute, class action, bringing of charges, legal proceeding, suit at law, judicial proceeding, legal contest, legal process, trial, impeachment, allegation, arraignment, and sued. We created this list by searching for synonyms for the words litigation and lawsuit. All climate change exposure risk premiums are in % p.a. after controlling for a 6-factor model (combination of 4- and 5-factor models) (in decimals p.a.) and stock characteristics (described in Section 3.2). As proxies for expected excess returns, we use the realized excess returns (RET), the forward-looking proxy by Martin and Wagner (2019) (MW), and the forward-looking proxy by Chabi-Yo et al. (2022) (GLB). All explanatory variables (except for the factor betas) are normalized at each point in time to have standard deviations of 0.01. t-statistics based on Newey and West (1987) standard errors with three lags are reported in parentheses. The sample covers the period from 01/2008 to 12/2020 and includes S&P 500 stocks.

	2005-2010	2011-2014	2015-2020
	(1)	(2)	(3)
$Green\ Innovation_t$	0.014	0.020	0.030
$Adaptation_t$	0.004	0.021	0.024
$ESG\ Fund\ Flows_t$	0.000	-0.001	0.007
$Oil\ Price_t$	0.032	0.042	0.023
$CO_2\ Price_t$	0.020	0.010	0.018
$Big\ Three\ IO_t$	0.000	-0.008	0.013

OA Table 9: Institutional and Market Factors over Time.
This table reports mean values of institutional and market factors across for three different subperiods: (i) 01/2005-12/2010 in Column 1; (ii) 01/2011-12/2014 in Columns 2; and (iii) 01/2015-12/2020 in Column 3. All variables are normalized to have a standard deviation of 0.01 for the full sample period. $CO_2\ Price_t$ start in 08/2005, and $Big\ Three\ IO_t$ goes until 12/2017. The sample includes S&P 500 stocks.



OA Figure 1: Risk Premium for Climate Change Exposure: Histograms for Perturbation t-statistics.
This figure shows histograms of the t-statistics for the risk premium for $CCExposure$, obtained separately for 50 perturbated $CCExposure$ measures. The risk premium is estimated using three proxies for the expected excess return: the realized excess returns (RET), the forward-looking proxy by Martin and Wagner (2019) (MW), and the forward-looking proxy by Chabi-Yo et al. (2022) (GLB). Risk premiums are estimated jointly with the 6-factor model (4- and 5-factor models combined) premiums and stock characteristics (described in Section 3.2). t-statistics are based on Newey and West (1987) standard errors with three lags. The sample covers the period from 01/2005 to 12/2020 and includes S&P 500 stocks.

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