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Climate change and global stock market returns

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Abstract

To the question of whether global stock market indices are sensitive to climate change, the answer is “Yes”. Using weekly data from the stock market returns of 97 countries over the period from 31 August 2020 to 18 April 2022, we document a significant negative impact of climate change on the performance of global stock indices.

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1. Introduction

There is a wider recognition among policy makers, practitioners and academics alike that climate change can pose risks to the economy in general and to the financial sector in particular. Combating climate change is becoming one of the most urgent priorities of our time (Borio et al. 2022). Indeed, climate change has a significant and direct impact on society, and therefore has the potential to affect investors' decisions (NGFS, 2020; Calice and Miguel, 2021). In addition, investors' concerns about climate change could negatively impact their performance (BoE, 2018; ECB, 2021)[1]. Indeed, physical climate risks (such as global warming, floods, extreme precipitation, drought) could affect the productive assets of companies and thus their performance (Pan and Qiu, 2022).

However, despite its importance, the analysis of the impact of climate change risks (notably the physical risk of huge climate-induced damage) on the performance of global stock indices has not been sufficiently explored so far[2]. Therefore, this paper is an attempt to fill this gap. We contribute to the understanding of how climate change concerns impact the performance of stock market indices around the world. To do so, we adopt as our proxy for climate change concerns the intensity of Google searches on terms related to climate change ("climate change", "temperature increasing", "global warming", "sea levels"), which offers a new perspective on the behavior of market participants in periods of stress (Moat et al. 2013; Preis et al. 2013). To analyze the optimism (or

[1] Wang et al. (2022) point out that investor sentiment affects stock returns.
[2] Previous studies have mainly focused on the sensitivity of Chinese stock returns to: (i) changes in the price of carbon (Hinterman, 2016); (ii) increases in temperature (Wen et al. 2020, Yan et al. 2022).

pessimism) of stock markets to climate change, we mobilize weekly stock return data from 97 countries over the period from 31 August 2020 to 18 April 2022. Our results highlight a significant negative impact of climate change on global equity indices' performance. We also observe that this impact is stronger for less polluting countries than for more polluting ones. Overall, stock market indices around the world are pessimistic about climate change.

The remainder of this paper proceeds as follows. Section 2 presents data and empirical model. Section 3 reports results. Section concludes.

2. Data and model

The level of our analysis is country-week and covers the period from 31 August 2020 to 18 April 2022. Weekly data of stock returns are computed from https://www.investing.com/, consisting of 8191 weekly observations[3]. We use the weekly log return of each stock index that reflects the overall performance of a specific stock market (Wang et al. 2022). Our sample is based on stock market returns in 97 countries around the world[4]. Data on search volumes related to the

[3] The choice of the time horizon is mainly related to the availability of data. However, we recognise that a longer time horizon would have been better for our analysis. Given the magnitude and concerns of climate change on a daily basis, we hope that the results of our analysis will shed some light.

[4] Algeria, Argentina, Australia, Austria, Bahrain, Bangladesh, Belgium, Benin, Bosnia-Herzegovinia, Botswana, Brazil, Bulgaria, Burkina Faso, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Ecuador, Egypt, Finland, France, Germany, Ghana, Greece, Hong-Kong, Hungary, Iceland, India, Indonesia, Iraq, Ireland, Israel, Italy, Ivory Coast, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Lebanon, Malaysia, Malta, Mauritius, Mexico, Mongolia, Montenegro, Morocco, Namibia, Netherlands, New-Zealand, Niger, Nigeria, Norway, Oman, Pakistan, Palestine, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Rwanda, Saudi Arabia, Senegal, Serbia, Singapore, Slovakia, Slovenia, South-Africa, South-Korea, Spain, Sri-Lanka, Sweden, Switzerland, Taiwan, Tanzania, Thailand, Togo, Tunisia, Turkey, Uganda, Ukraine, United Kingdom, United Arab Emirates, United States, Venezuela, Vietnam, Zambia, and Zimbabwe.

climate change was obtained from Google Trends. Internet searches via Google Trends (like Wikipedia Trends) are considered as a metric to express the public interest in a topic (in our case "climate change")[5]. Therefore, high interest can express anxiety (stress) or intensity and therefore allows for the analysis of stock market reactions (Moat et al. 2013).

Using panel data, we investigate the response of world stock market returns to climate change. The panel data describes a worldwide sample of 97 countries and is estimated as follows:

$$Stock_{c,w} = c + \alpha_1 Climate_{c,w} + \theta_w + \lambda_c + \varepsilon_{c,w} \qquad (1)$$

where $Stock_{c,w}$ denotes the log returns of the stock market index of country c on week w. $Climate_{c,w}$ represents the log returns of Google Trends search data in country c on week w, related to climate change. It measures the intensity (or anxiety) of internet searches related to climate change (such as climate change, global warming, temperature increasing, and sea levels).

Being in weekly frequency, it is more difficult to obtain macroeconomic controls at this frequency (with a lot of variability) that could be related to stock returns. Therefore, we include fixed effects in our estimates to control for unobservable factors. Our regressions control for time fixed-effects, θ_w, absorbing a level shift for each week, capturing the overall trend. The country fixed-effects, λ_c, absorbs

[5] Google Trends is widely used as a sentiment indicator (see Da et al. 2011, 2015).

the different fixed and time-invariant levels of search intensities across countries. The standard errors are robust and clustered at the country level.

3. Results

In this section, we present the results of the impact of Google searches related to climate change on the performance of global stock indices. Our baseline results are reported in Table 1, considering several specifications.

Table 1. Climate change and global stock returns

	Stock returns			
	(I)	(II)	(III)	(IV)
Climate change	-0.002***	-0.001***	-0.014*	-0.145**
	[0.00]	[0.00]	[0.01]	[0.06]
Observations	8191	8191	8191	8191
Number of countries	96	96	96	96
R2 (within)	0.011	0.028	0.011	0.124
Week fixed-effect	No	Yes	No	Yes
Country fixed-effect	No	No	Yes	Yes

Notes: Robust stantard errors clustered at the country level are presented in brackets. ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

Our findings highlight that the performance of global stock indices is negatively and significantly associated with climate change. Indeed, our results suggest that concerns about climate change lead to underperformance of stock market indices worldwide. This result remains unchanged even when considering other proxies reflecting concerns about climate change developments such as "temperature

increasing", "global warming" or "sea levels" (see Table 2)[6]. Our findings therefore reflect the awareness of financial markets to climate change fears[7].

Table 2. Other measures of climate change

	Stock returns		
	(I)	(II)	(III)
Temperature increasing	-0.075***		
	[0.02]		
Global warming		-0.033**	
		[0.01]	
Sea levels			-0.025***
			[0.01]
Observations	7853	8191	8191
Number of countries	94	96	96
R2 (within)	0.04	0.026	0.026
Week FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes

Notes: Robust stantard errors clustered at the country level are presented in brackets. ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

We complete our analysis by investigating the responses of stock market indices to climate change according to the contribution of countries to the acceleration of climate change, particularly in terms of CO2 emissions[8]. Among the most polluting countries in terms of CO2 emissions are Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Saudi Arabia, South Africa, South Korea, Taiwan, Ukraine, United Kingdom, and United States. Conversely, we consider the other countries in the sample to be

[6] Using country weather data, we continue to observe that stock market indices react negatively to rising temperatures (available on request).
[7] Other studies have shown that stock market indices are also sensitive to other events, such as rising uncertainty (Chiang, 2019), war (Boungou and Yatié, 2022) and terrorism (Arin et al. 2008).
[8] Country rankings: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf

less polluting, although the contribution to climate change, however small, is one too many. Table 3 reports the results of this analysis. We continue to observe a significant negative reaction of stock market indices to climate change. Nevertheless, our results highlight that the stock market indices of the most CO2 emitting countries are not necessarily the most sensitive to climate change. In other words, the impact of climate change on the performance of stock market indices was stronger for countries with lower CO2 emissions compared to countries that emit more CO2. Overall, our results support the claim that tackling the slowdown in climate change should not be a matter for any one country or group of countries, but rather should be a matter of common, global action. For the inaction (or selfishness) of some countries can reduce the action of others to zero and thus have a negative and lasting impact on the rest of the world.

Table 3. Highest vs. lowest polluter countries

	Stock returns	
	Lowest polluter countries	Highest polluter countries
Climate change	-0.178**	-0.004**
	[0.07]	[0.00]
Observations	6460	1731
Number of countries	76	20
R2 (within)	0.146	0.315
Week fixed-effect	Yes	Yes
Country fixed-effect	Yes	Yes

Notes: Robust stantard errors clustered at the country level are presented in brackets. ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

In order to remove the potential impact of the ongoing conflict between Ukraine and Russia on stock market indices, we limit our sample to the period before

Russia invades Ukraine on 24 February 2022. This allows us to check whether our results are not influenced by this event as this war has negatively and significantly impacted the world stock market indices (Boungou and Yatié, 2022), even if the impact was heterogeneous between countries (Boubaker et al. 2022). The results of this analysis are reported in Table 4 and support our baseline.

Table 4. Over the period before Ukraine-Russia's war

	Stock returns
	Before Ukraine-Russia's war
Climate change	-0.052***
	[0.01]
Observations	7398
Number of countries	96
R2 (within)	0.38
Week fixed-effect	Yes
Country fixed-effect	Yes

Notes: Robust stantard errors clustered at the country level are presented in brackets. ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

Finally, we complete our analysis by including in our estimates a set of controls to further attempt to isolate the responses of stock market indices to climate change. To do so, we include three additional variables, namely the cumulative weekly number of COVID-19 deaths as a percentage of the population (COVID-19), the financial market volatility index (VIX) and the percentage of people vaccinated against COVID-19 (Vaccination). The inclusion of these additional controls leaves our conclusions unchanged. We still observe a significant negative impact of climate change concerns on the performance of global stock market indices.

Table 5. Additional controls

	Stock returns			
	(I)	(II)	(III)	(IV)
Climate change	-0.145**	-0.145**	-0.010*	-0.022**
	[0.06]	[0.06]	[0.00]	[0.00]
COVID-19	-0.030***			-0.039***
	[0.01]			[0.00]
VIX		0.147		-0.023***
		[0.10]		[0.00]
Vaccination			0.001	0
			[0.00]	[0.00]
Observations	8191	8191	4834	4834
Number of countries	96	96	94	94
R2 (within)	0.124	0.124	0.139	0.139
Week fixed-effect	Yes	Yes	Yes	Yes
Country fixed-effect	Yes	Yes	Yes	Yes

Notes: Robust stantard errors clustered at the country level are presented in brackets. ***, **, and * stand for significance at the 1%, 5%, and 10% levels, respectively.

Overall, the results of this analysis shed light on the impact of climate change on the performance of global stock indices. We find that stock market indices react negatively and significantly to climate change concerns.

4. Conclusion

Using data on the performance of stock market indices from 97 countries over the period from 31 August 2020 to 18 April 2022, this paper investigates the influence of climate change on the performance of these indices at the global level. Our analysis highlights the significant negative impact of climate change on stock market returns worldwide.

In sum, the results of our analysis should at least raise awareness of the financial impact of climate change if nothing is done to tackle it. Especially since the impact

of climate change on the performance of stock market indices was stronger for countries with low CO2 emissions than for countries with high emissions. Therefore, policy makers must realize that climate change has become an unavoidable issue and they should therefore accelerate the integration of climate risk into their policies.

References

Arin P., Ciferri D., Spagnolo N., 2008. The price of terror: The effects of terrorism on stock market returns and volatility. *Economics Letters*, Vol. 101, Issue 3, pp. 164-167.

Bank of England (BoE), 2018. Climate change: what are the risks to financial stability?

Borio C., Cl aessens S., Tarashev N., 2022. Finance and climate change risk: Managing expectations.VoxEU.org, 07 June 2022.

Boubaker S., Goodell J., Pandey D., Kumari V., 2022. Heterogeneous impacts of wars on global equity markets: Evidence from the invasion of Ukraine. *Finance Research Letters*, Volume 48, 102934.

Boungou W., Yatié A., 2022. The impact of the Ukraine-Russia war on world stock market returns. *Economics Letters*, Vol. 215, 110516.

Calice P., Miguel F., 2021. Climate-related and environmental risks for the banking sector in Latin America and the Caribbean. World Bank, Policy research working paper, No. 9694.

Chiang T., 2019. Economic policy uncertainty, risk and stock returns: Evidence from G7 stock markets. *Finance Research Letters*, Vol. 29, pp. 41-49.

Da Z., Engelberg J., Gao P., 2011. In search of attention. *Journal of Finance*, Vol 66, No. 5, pp. 1461-1499.

Da Z., Engelberg J., Gao P., 2015. The sum of all FEARS investor sentiment and asset prices. *Review of Financial Studies*, Vol. 28, No. 1, pp. 1-32.

European Central Bank (ECB), 2021. Climate change and monetary policy in the euro area. ECB Strategy Review, Occasional paper, No. 271/ September 2021.

Hintermann B., 2016. Pass-through of CO2 emission costs to hourly electricity prices in Germany. *J. Assoc. Environ. Resour. Econ*. 3 (4), 857–891.

Moat H., Curne C., Avakian A., Kenett D., Stanley E., Preis T., 2013. Quantifying Wikipedia usage patterns before stock market moves. *Scientic Reports*, 3, 1801.

Pan X., Qiu B., 2022. The impact of flooding on firm performance and economic growth. *Plos One*, 17(7): e0271309.

Preis T., Moat H., Stanley H., 2013. Quantifying trading behavior in financial markets using Google Trends. Scientific Reports, No. 1684, 25 April 2013.

Wang W., Su C., Duxbury D., 2022. The conditional impact of investor sentiment in global stock markets: A two-channel examination. *Journal of Banking and Finance*, Vol. 138, 106458.

Wen F., Wu N., Gong X., 2020. China's carbon emissions trading and stock returns. *Energy Economics*, Vol. 86, 104627.

Yan Y., Xiong X., Li S., Lu L., 2022. Will temperature change reduce stock returns? Evidence from China. *International Review of Financial Analysis*, Vol. 81, 102112.