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Stormy Forecasts: How Climate Policy Uncertainty Drives Index Returns

A cross-country and -sectoral comparison

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Abstract

This paper investigates the relation between climate policy uncertainty (CPU) and stock market performance, highlighting national – and sectoral differences. Utilizing the CPU index from Gavriilidis (2021), I perform a reversed unrestricted mixed data sampling regression (RU-MIDAS) to analyse 33 countries over the period 2004-2020. The results reveal a divergence in the effect of CPU on stock returns with a positive and significant effect observed in several European countries. Given the EU's stringent environmental policies, this suggests that being a frontrunner in the climate transitions presents opportunities rather than challenges. This paper contributes to academic literature by confirming and extending findings of recent studies and adds to the growing body of work on climatological effects on financial markets worldwide.

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Introduction

Ever since the signing of the Paris agreement in 2015[1], the world set itself a legally binding target of limiting the increase in mean global temperature to 2°C. With governments worldwide imposing climate policies, being at times ambiguous and of changing nature, a lot of uncertainties can arise around climate policy, injecting risk into the market and the profiles of firms.

Recent studies have demonstrated a wide array of financial effects of policy uncertainty on economic outcomes. Academics show, for example, a positive relation between CPU and dividend payouts (Ayed et al., 2014), but also a negative effect of CPU on productivity within Chinese firms in dirty sectors (Ren et al., 2022). Further, it was found that CPU influences stock market volatility (Lasisi et al., 2022; Lv and Li, 2023) and also the volatility of sovereign bond returns (Jia et al., 2024). Recently, Tedeschi et al. (2024) found a positive effect of CPU on clean energy stock prices. Moreover, prior research show that the effects of economic policy uncertainty shocks are country specific (Istiak & Serletis, 2018). This divergence in effects is later found to be coherent for CPU when studying China and the US by Xu et al. (2023).

Despite the growing attention to the topic and the relevance to a wide variety of markets, much remains unclear about the relation between CPU and stock market performance, particularly in terms of sectoral – and national differences. Therefore, this study aims to extend on existing literature by investigating the effect of CPU on sectoral – and national benchmark indices. Considering national differences, I also test the moderating effect of a country its exposure to extreme weather, fossil fuel dependency, climate change related media coverage and elite cues.

Prior studies have tested multiple theoretical arguments about the difference in the effect CPU can have on sectors. Looking at transition risk and the potential of financial impact of assets stranding (Sen et al., 2020), carbon pricing risk and the possibility of dirty companies losing their competitiveness (Breitenstein et al., 2022; Mo et al. 2021) and R&D risk and firms' 'wait-and-see' strategy lacking innovations (Fuss et al., 2008; Hoang, 2022), these arguments predict a negative association between CPU and capital intensive, dirty and R&D intensive sectors respectively. Further theoretical arguments suggesting climate change becoming more cognitively available after experiencing extreme weather events (Donner and McDaniels, 2013; Demski et al., 2017) predict a moderating effect of these extreme weather experiences on the relation between CPU and stock performance. A similar moderating effect is to be expected from climate change related media coverage and elite cues, given the results from Carmichael and Brulle (2016) which address that both these factors lead to a higher public concern on climate change. Finally, a country highly dependent on fossil fuel is less prone to see climate change as a threat (World Risk Poll, 2021), predicting a moderating effect of fossil fuel dependence.

[1] The Paris Agreement is a legally binding international treaty on climate change. See https://unfccc.int/process-and-meetings/the-paris-agreement

To empirically examine the effect of CPU on stock market performance, the “Climate Policy Uncertainty Index” will be used (Gavriilidis, 2021). This index is constructed by searching for climate policy uncertainty related tags (e.g. “greenhouse” AND “regulation”) in eight leading US newspapers starting in 1987. The results are normalized so that they can be compared overtime.

Using a reversed unrestricted mixed data sampling (RU-MIDAS) regression (Foroni et al., 2018), allowing for mixed frequency data, I analyse 33 countries ranging from 2004 to 2020. I find a divergence in the effect of CPU. Additionally, no constant significance is found. However, for several countries a positive significant effect of CPU was identified. Their common denominator suggesting that being a front runner in the climate transition creates more opportunities than challenges for these countries.

This paper contributes to academic literature in multiple ways. First, it once more confirms and extents the findings of recent studies (Tedeschi et al., 2024; Xu et al., 2023) that addressed the effect of CPU on financial markets in the EU and the difference in effects of CPU between the US and China. Second, this paper adds to the growing literature around the effect of climate (policies) on financial markets worldwide (e.g. Ayed et al., 2014; Jia et al., 2024).

The remainder of the paper is structured as follows: section 2 provides a theoretical background in the form of a literature review. In section 3 the methodology, including data, variables and models are discussed. In section 4 the results are presented and discussed. Section 5 concludes the research with recommendations and the contributions to existing literature.

2. Literature review

The focus of this study is to address the cross-country and cross-sectoral differences of the effect of climate policy uncertainty (CPU) on stock performance. In the following section, I review the literature on policy uncertainty and discuss the literature on economic channels through which sectoral and national differences can be expected to operate.

2.1 Policy uncertainty

There are several papers on the economic effects of policy uncertainty, however, scholars do not reach a consensus as to whether the effects are positive or negative. A negative effect was found in research from Batten et al. (2016). They examine the impact of climate change on the monetary policy and financial stability objectives of central banks. The paper shows that a sudden unexpected tightening of carbon emission policies could lead to a disorderly repricing of carbon-intensive assets and generate a negative supply shock. This could lead to significant balance sheet losses and financial instability. Additionally, Sendstad and Chronopoulos (2020) developed a real options framework to analyse the impact of, amongst others, policy uncertainty on the decision to invest in improved versions of renewable energy technology. They show that a greater likelihood of subsidy retraction postpones investment and vice-versa. Also, Ren et al., (2022) finds that CPU significantly reduces firm -level total factor productivity and Persakis (2023) finds a reduction in firm performance.

He et al. (2020) on the other hand, investigate the effects of economic policy uncertainty (EPU) on corporate innovation in China. They conclude that EPU has a significant positive impact on enterprise innovation, but the severity varies between enterprise characteristics such as industry type. Further, academics address the positive relation between both CPU and EPU and the ESG performance of firms (Persakis, 2023; Zhao 2023), a vital component for business in the past years. Likewise, Vo et al. (2024) finds a positive relation between CPU and a firm its corporate social responsibility (CSR) investments. They highlight that this relation is stronger for firms operating in carbon-intensive industries, suggesting firms strategically engage in these CSR investments to mitigate the risk associated with CPU.

H1: CPU has a negative effect on stock performance

2.2 Sectoral differences

As with so many other factors influencing the stock market, a different effect of CPU on stock market performance can reasonably be expected when comparing sectors. As shown by Bouri et al. (2022), CPU is a significant determinant of the performance of green energy stocks relative to brown energy stocks. Meaning investors prefer green- over brown equity during times of high(er) climate policy uncertainty.

2.2.1 Transition risk

When comparing sectors, the effect of CPU on stock market performance can be seen through the lens of transition risk. There is a lot of policy uncertainty around the pace and direction of policy in transitioning to greener alternatives. Especially for capital intensive industries this involves a risk of 'stranded assets'. These are assets a firm seizes to use before the end of the asset its anticipated economic lifetime. As mentioned earlier, when CPU is followed by an unexpected tightening of climate policy stringency, this might lead to a disorderly repricing of assets (Batten et al., 2016). This in turn might lead to the pursuit of other investments and the stranding of assets not deemed worthy investing in anymore. For capital intensive industries (e.g. energy sector and utilities sector) this involves the direct risk of costly assets stranding. However, it can also involve an indirect risk. Firms within the financial sector, for example, might be affected due to high exposure toward the assets stranded.

Research from Sen et al. (2020) investigates the stock market effects of a German climate policy proposal aimed at stranding assets. The proposal challenged the consensus of a compensation scheme for stranding fossil fuel assets. When testing the effects of the news about this proposal, their most conservative 5-day CARs estimate a loss of over 20%. This shows the substantial effect of climate policy on the performance of the stock market.

Furthermore, these assets, especially those in the fossil energy market, are most often exploited during a long period of time and require a large initial investment. These long-term investments cause a "lock-in" effect of carbon intensive technologies (Erickson et al., 2015). However, this effect is undesirable as countries are striving towards the goals of the Paris Agreement (i.e. reduce global warming to 2°C).

Other research extends on this by showing that investments in fossil capacities after 2017 are inefficient, because they lead to larger carbon "lock-ins", as well as, the need for deeper emission cuts afterwards (IPCC, 2014). To achieve the agreed upon emission cuts, companies would have to strand their polluting assets. Given their size and interrelation with the rest of the economy, the risk of sunk cost goes beyond only the energy industry (Sen et al., 2020). Conservative estimates reveal that the energy industry alone faces a sunk cost of $129 billion due to the stranding of fossil fuel plants (IEA, 2013). Other research approximates losses of up to $500 billion and reveals that the regions most affected are Asia-Pacific, Europe, and the US (Dulong, 2022).

H2: CPU has a negative effect on the stock performance of firms in 'capital-intensive' sectors

2.2.2 Carbon pricing risk

Besides transition risk, the sectoral differences regarding the relation between CPU and stock market performance can also be seen in the context of carbon pricing risk[2]. Carbon pricing induces risk and uncertainty, especially in 'dirty' sectors. High carbon prices can create economic conditions in which dirty companies lose their competitiveness (Breitenstein et al., 2022; Mo et al. 2021). It might even accelerate the earlier mentioned stranding of assets and a lowering of industry valuations (Breitenstein et al., 2022). In addition to the earlier mentioned rationale of the effect of CPU on stranding assets, for dirty sectors there is a great chance the tightening in climate policy stringency influences their core business model. Therefore, CPU increases the potential of their assets stranding.

The opaqueness of policy regarding the Paris Agreement on whether to achieve the 2°C target or 'aim' for the 1.5°C target, induces a risk. If policies become more stringent and therewith carbon prices becoming higher, the chances of stranding assets and loss in stock value in dirty sectors increases (Mo et al, 2021).

H3: CPU has a negative effect on the stock performance of firms in 'dirty' sectors

2.2.3 Research and Development risk

Furthermore, there is a lot of uncertainty around the improvement of technology itself. If we were to look ahead of the curve and sidestep our problems in the present, it can be concluded that the solution to many of our climate problems lies in future technology. How fast anti-carbon technology develops is partly dependent on climate policy. Firms, in particular ones with substantial R&D expenditures, will therefore keep a close eye on climate policy. Academics however, seem to fail to a consensus on the effect of policy uncertainty on R&D.

Research from Bai et al. (2023) explores the impact of CPU on corporate green innovation in Chinese A-share industrial enterprises. The study shows that CPU contributes to firms' green innovation and that this positive relation is stronger for energy production and technology intensive firms. Similar research from Atanassov et al. (2015) supports these findings. They found that governmental policy uncertainty encourages R&D investments and additionally makes firms use their R&D dollars more efficient. However, their research focusses on uncertainty caused by the impact of gubernatorial elections and not climate policy.

On the other hand, there is also some research suggesting a negative relation between CPU and R&D. In a study examining the impact of uncertainty on R&D, Khan et al. (2020) finds a negative

[2] The financial risk that carbon-intensive industries may face due to rising carbon costs. See https://www.pwc.com/gx/en/issues/esg/the-hidden-cost-of-carbon.html

relationship between uncertainty and R&D investments in Chinese firms. Other research elaborates on this by addressing the fact that this negative relation is more pronounced with heavy emitters (Hoang, 2022). Hoang (2022) also finds that when heavy emitters face technological uncertainty in combination with increased CPU, they tend to play the 'wait-and-see' strategy by reducing R&D investments until more is known about climate policy. Results from Fuss et al. (2008) also show the presence of a 'wait-and-see' strategy in the energy sector as a consequence of policy uncertainty. Additionally, they conclude that investors' profits are reduced during this 'waiting time', when governments proceed with raising CO_2 prices afterwards. This reveals a link between high CPU, delayed or cancelled R&D investments, more carbon emissions and, the earlier mentioned, higher carbon pricing (Su et al., 2024).

Finally, research from Syed et al. (2023) goes as far as to argue that CPU impedes not only R&D investment, but also overall technological advancements and clean energy investments. Moreover, it has been noticed that new governments often abolish the policies of the old government and replace them with new polies, which in turn generates more CPU. Therefore, in contrast to the earlier mentioned wish of quick adaptation to climate problems, the authors call for a very slowly introduction of climate policies, to reduce the negative effects of uncertainty (Syed et al., 2023).

H4: CPU has a negative effect on the stock performance of firms in 'R&D intensive' sectors

2.3 National differences

As previously explained, research from Xu et al. (2023) already opens the conversation on the effect of national differences on the relation between CPU and stock market performance. They investigate the differences between China and the US and come to the insight that for China (1) low CPU does not affect stock market return, but high CPU potentially does have a decreasing effect. (2) The short-term is, contrary to the long-term impact, positive. (3) In the short-term, CPU increases stock market volatility, however, in the long-term this decreases again. In the US on the other hand, Xu et al. (2023) find that (1) CPU could decrease stock market return in short-term, but increase it in the long-term. (2) CPU increases volatility in the short term, then decreases volatility in the mid-term (i.e. after 5 months), and thereafter again have an increasing effect in the long-term (i.e. after 6 months).

Additional national discrepancies can be found between the effect of CPU and economic policy uncertainty (EPU) on green activities. Research from Hong et al. (2024) finds a positive relation between both CPU and EPU and firms' green activities when investigating Vietnamese listed companies. However, Huang (2023) finds that for U.S. firms during a similar period, the results indicate a negative relation between CPU and firms' green patenting activities.

2.3.1 Exposure to extreme weather events

A considerable body of academic literature deals with the cross-country differences in exposure to climate risk in the form of extreme weather events (i.e. floods, drought, etc.). There is a somewhat consensus on the presence of the availability heuristic[3] when it comes to the perception of climate change (Weber, 2010; Keller et al., 2006; Taylor et al., 2014a). Meaning that people experiencing extreme weather are more aware of climate change.

Elaborating on the prior, Donner and McDaniels (2013) found that when temperatures are higher, the public in the US tends to be more convinced of, as well as worried about, human-caused climate change. Similar results are retrieved from UK data (Demski et al., 2017). They show that climate change becomes more cognitively available following flooding experiences and that people with 'experience' perceive a higher threat. Although, this experience is ought to be during a longer period (i.e. 1 month – 1 year) to influence the perception of climate change (Carmichael and Brulle, 2016; Deryungina et al., 2013). Other research from Brody et al. (2007) goes one step further and argues that even when lacking extreme weather experience, people tend to register climate change risk when the threat is most overt. Meaning that physical position (e.g. close to the sea) already increases public perceptions of the potential negative impacts of climate change.

Contrary to prior literature, research from Carmichael and Brulle (2016) claims that weather events in themselves have little influence on the overall public concern of climate change. They find that only long-lasting periods of extreme drought have a positive significant effect on public concern. They argue that their findings differ from the consensus, because they focus on a larger jurisdiction and it is not likely that local weather events impact national opinion.

H5: Experiencing extreme weather events has a moderating effect on the relation between CPU and stock performance.

2.3.2 Media coverage and elite cues

A second body of literature dealing with climate perception, extents on the earlier mentioned availability heuristic regarding media coverage and elite cues[4]. Although the coverage of climate related topics in major agenda-setting media is partly caused by experiences with extreme weather (Donner and McDaniels, 2013), media coverage has an effect coming from itself. Research from Carmichael and Brulle (2016) finds that media coverage of climate change directly affects the level of public concern. Meaning, more media coverage leads to a higher public concern. They relate this to a limited amount of

[3] A mental shortcut relying on available information in a person's mind.

[4] Signals from influential authoritative sources (e.g. political leaders, economic experts and major policy makers). See https://epicenter.wcfia.harvard.edu/blog/elite-cues-or-social-cues-formation-public-opinion-foreign-policy

'issue space' within a society, explaining that climate change must compete with other societal issues such as unemployment, involvement in wars and economic prosperity. Feldman et al. (2015) adds a degree of distinction by focussing on hostile media perceptions. Their research shows that these hostile media perceptions may speak to and activate liberals who sympathize with the topic of climate change. For those doubtful about global warming however, it might lead to further alienation and disengagement.

Furthermore, researchers agree on the overarching importance of government policy regarding climate change (Ockwell et al., 2009; Carmichael and Brulle, 2016; Feldman et al., 2015). Carmichael and Brulle (2016) find that the most important factor influencing public opinion on climate change is elite cues in the form of congressional attention to climate change. This in turn also effect media coverage, which then affects public concern about climate change.

H6.1: Media coverage has a moderating effect on the relation between CPU and stock performance

H6.2: Elite cues have a moderating effect on the relation between CPU and stock performance.

2.3.3 Fossil fuel dependency

In another light, national differences can be expected when it comes to a country its fossil fuel dependency. According to World Risk Poll (2021), challenges with regards to climate can be expected when a persons' livelihood and quality of life is inextricably linked with the fossil fuel industry. They find evidence that people in countries with a significant reliance on fossil fuels are less likely to view climate change as a threat. They emphasize that it often concerns countries with a high dependence on fossil fuel production. Ide (2020) confirms that dependence on fossil fuel for energy generation is identified as a key condition for countries with insufficient contributions to the targets from the Paris agreement.

H7: Fossil fuel dependency has a moderating effect on the relation between CPU and stock performance

3. Methods

3.1 Data

To investigate the effect of climate policy uncertainty on both stock returns of global indices and the corresponding sectoral indices, I retrieved data from a large variety of sources which are described below (see Table 2). After dropping countries unavailable in the Environmental Policy Stringency Index (EPSI), 33 countries remained. From these 33, 27 are OECD member countries[5] and the remaining six are Brazil, China, India, Indonesia, Russia, and South Africa. For these countries data was retrieved between 2004 and 2020, imposed by limitations in Google Trends data and the EPSI data respectively (see Table 1).

3.1.1 National – and sectoral indices

Stock market performance data was retrieved from the LSEG database. LSEG contains detailed historical financial information on index products. Stock data with a monthly frequency was chosen because of time scale consistency with other variables and to smooth out short-term fluctuations in the data.

To analyse the impact of climate policy uncertainty on both the overall market within a country, as well as, the effect on specific sectors within this market, both national – and sectoral indices were used. As for the national indices I used a country its benchmark index (e.g. AEX, S&P500, DAX, etc.) (see Table 1). For the sectoral indices I followed the commonly used Global Industry Classification Standards (GICS)[6] by MSCI to reassure a consistent industry definition. The GICS industry analysis framework distinguishes the following 11 sectors: *Energy, Materials, Industrials, Consumer Discretionary, Consumer Staples, Health Care, Financials, Information Technology, Communication Services, Utilities and Real Estate* (see Appendix A). Due to data limitations, in some cases small-cap and/or mid-cap sector indices have been used (see Appendix A). However, due to high correlations small-cap and mid-cap indices with the sector as a whole, this will not impose any significant issues. Furthermore, no sector index data was available for Russia, Slovakia, and Slovenia.

[5] See https://www.oecd.org/about/
[6] See https://www.msci.com/our-solutions/indexes/gics

Table 1. National benchmark stock indices

Country	National Benchmark Index	Ticker	Country Code
Australia	S&P/ASX 200	.AXJO	AUS
Austria	ATX	.ATX	AUSTR
Belgium	BEL 20	.BFX	BEL
Brazil	Bovespa index	.BVSP	BRA
Canada	S&P/TSX	.GSPTSE	CAN
Czechia	INDEX PX	.PX	CZE
Denmark	OMXC 20	.OMXC20	DEN
Finland	OMXH 25	.OMXH25	FIN
France	CAC 40	.FCHI	FRA
Germany	DAX	.GDAXI	GER
Greece	ASE	.ATG	GREE
Hungary	BUX	.BUX	HUNG
India	SENSEX	.BSESN	INDIA
Indonesia	JKSE	.JKSE	INDO
Ireland	ISEQ	.ISEQ	IRE
Italy	FTSE MIB	.FTMIB	ITA
Korea	KOSPI 200 INDEX	.KS200	KOR
Netherlands	AEX	.AEX	NL
Norway	OBX	.OBX	NOR
Poland	WIG 20	.WIG20	POL
Portugal	PSI 20	.PSI20	POR
Russia	MOEX RUSSIA	.IMOEX	RUS
Slovakia	SAX	.SAX	SLOVA
Slovenia	SBITOP	.SBITOP	SLOVE
South Africa	FTSE/JSE SA ALL-SHARE	.JALSH	SOAF
Spain	IBEX	.IBEX	SPA
Sweden	OMXS 30	.OMXS30	SWED
Switzerland	SMI	.SSMI	SWIT
Turkey	BIST 100	.XU100	TUR
UK	FTSE	.FTSE	UK
Japan	NIKKEI 225	.N225	JAP
China	CSI 300	.CSI300	CHI
US	S&P 500	.SPX	US

Note: This table presents a country with its corresponding benchmark index alongside the ticker and the country code used in this study. Source: LSEG & Author.

3.1.2 Climate Policy Uncertainty index

To empirically examine the effect of CPU on stock market performance, the "Climate Policy Uncertainty Index" was used (Gavriilidis, 2021) (see Figure 1). This index is constructed by searching for climate policy uncertainty related tags (e.g. "greenhouse" AND "regulation") in eight leading US newspapers starting in 1987, leading to a monthly indexation of climate policy uncertainty. The results are normalized so that they can be compared overtime. The index is used frequently by academics (e.g. Bouri et al., 2022; Tedeschi et al., 2024). The CPU index determines U.S. climate policy uncertainty, but due to the U.S. being a large and influential economy, the index can be used to reflect worldwide climate risks (Tedeschi et al., 2024).

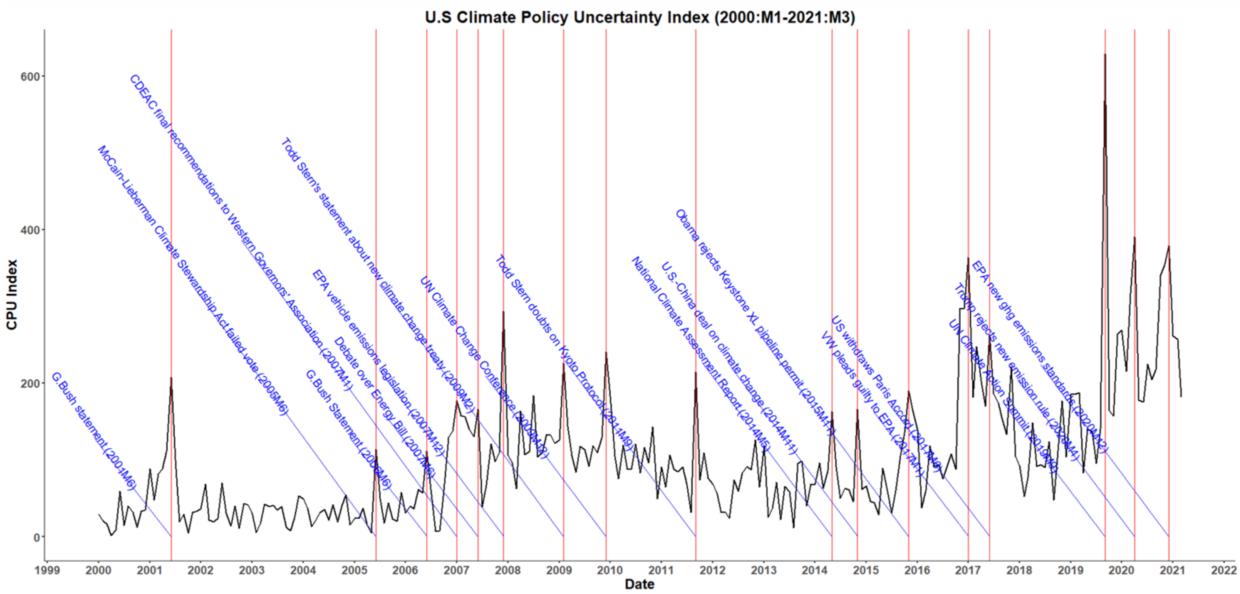

Figure 1. Annotated CPU index

Note: Adapted from Gavriilidis (2021)

3.1.3 Extreme weather events

To include a country its exposure to extreme weather events and natural disasters, the *emdat.be* database was used. However uncommon, it has been used in financial research before (e.g. Lee & Chen, 2020) and provides valuable insights on the moderating effects of a country its exposure to natural disasters and extreme weather. The database keeps track of all hazards and disasters worldwide. The data was filtered for 'natural events', resulting in the following four categories: *Climatological Hazards, Geophysical Hazards, Hydrological Hazards, and Meteorological Hazards* (see Appendix B). For two of these, *Geophysical* - and *Hydrological Hazards*, a binary indicator was used (0 = event does not occur in respective month; 1 = event occurs in respective month), because the occurrence of the event is of greater significance than the duration of the event. Illustrative examples are an earthquake and a flood, which are Geophysical and Hydrological events respectively. For the other two categories, *Climatological* – and *Meteorological Hazards*, the duration of the events is also of importance. For these categories, the monthly duration of such events was used. Besides the intuitive reasoning that the duration of, for example, a heat wave (meteorological event) is significant, because a heat wave lasting a day is not a heat wave but just a hot day, research from Deryungina et al., (2013) addresses the importance of the duration of a natural disaster. Finally, if, for any event of any category, the start or end day was missing, this missing value was replaced by 1 and 31 respectively. Similarly, if the start or end month was missing, the missing value was replaced by 1 and 12 respectively.

3.1.4 Media coverage

To address the effect of climate related media coverage on stock returns, the Factiva database was used. Factiva is an international news database produced by Dow Jones. The database was searched with a "Climate Change" subject filter (code: GCLIMT). This filter returns articles about: Long-term fluctuations in temperature, precipitation, wind and all other aspects of the earth's climate, global warming, the greenhouse effect, and carbon dioxide emissions. Together with a country specific source filter, this returns all articles about "Climate Change" within a specific country each year. Finally, the absolute number of climate related articles is divided by non-climate related articles to end up with a yearly media coverage ratio. Resulting in the following equation:

$$Media\_cov_{i,t} = \frac{Climate\ related\ articles_{i,t}}{NON\ Climate\ related\ articles_{i,t}}$$

3.1.5 Elite cues

To approximate the effect of elite cues (i.e. signals from authoritative sources) two variables were used. (1) The environmental policy stringency index and (2) Google Trends keyword index (GTKI). The EPSI is created by the OECD[7] providing a country-specific and internationally comparable measure of the stringency of environmental policy in a country.

Like prior research from Preis et al. (2013), the GTKI was created by retrieving data from Google Trends on the relative popularity of a keyword. The data is normalized with respect to time and location. A selection of 25 climate change related keywords was made, justified by academic literature (see Appendix C). Then, all were assigned a weight between 0 and 1, based on relative importance of those topics to the hypothesis (see Appendix C). Afterwards, for every country a monthly index value is created by summarizing the weighted interest in the 25 keywords. Then, to reduce the skewness of the distribution, the natural logarithm of the index was taken. Finally, to account for index values of *0*, a constant of *1* was added. Resulting in the following equation:

$$Gtrends_{i,t} = \ln\left(\sum_{i=1}^{25} w_{i,t} * k_{i,t} + 1\right)$$

With i = a keyword, running from $i = 1$ to $i = 25$. $w_{i,t}$ Is the weight of the i-th keyword at time t and $k_{i,t}$ is the keyword search interest of the i-th keyword at time t (see Appendix C). If a keyword did not

[7] See https://stats.oecd.org/Index.aspx?DataSetCode=EPS

display any search data, Google did not have enough search data for that keyword at that point in time for that specific country. If this was the case, a keyword interest of 0 was assumed.

Combining the EPSI – and the GTKI approximates the effect of elite cues. The rationale behind this is that, similar to the findings of Carmichael and Brulle (2016) (1) environmental policies are typically formed by governments, reflecting the priorities, actions, and commitment of the political elite. Besides that, (2) investor attention often follows from elite discussions. Therefore, higher investor attention, captured by the GTKI, indicates heightened cues from financial elites. However uncommon in financial literature, the field of medicine and healthcare already showed an ability to measures the effect of public healthcare announcements (Dagher et al, 2021) and policy changes (Ghosh et al, 2021) with Google Trends data. Hence, combining the two indices will create a proxy which includes both the effect of financial – and political elite cues.

3.1.6 Fossil fuel dependency

Data on fossil fuel will be retrieved from *ourworldindata.org*. This database provides global data on 'the world's largest problems' on a yearly basis. To approximate a countries fossil fuel dependence, two variables were used. (1) Fossil fuel consumption per capita, this is measured as the average consumption of energy from coal, oil, and gas, in kilowatt-hours (kWh) per person. And (2) Share of primary energy consumption from fossil fuels, this is measured as a percentage of primary energy[8].

3.1.7 Control variables

To control for other factors influencing stock index returns, several control variables, describing broader economic conditions, were included. A country its GDP growth rate and inflation rate both on a yearly frequency and therefore lagged, retrieved from *data.worldbank.org*. Additionally, the gold price, VIX index, BEX-RAI index and the Baltic dry index are included as control variables. The VIX index is a popular and commonly used volatility index from the Chicago Board Options Exchange (CBOE). The BEX-RAI index is a risk aversion index created by Bekaert et al. (2019) retrieved from *nancyxu.net*. The Baltic dry index (BADI) is an important indicator of bulk shipping rates published by London's Baltic Exchange, retrieved from *investing.com*. This results in the following control variable equation:

$$X_{i,t} = \beta_0 + \beta_1 * GDP\_lagged_{i,t} + \beta_2 * CPI\_lagged_{i,t} + \beta_4 * Gold\_price_t + \beta_5 * BEX\_RAI_t + \beta_6 * Baltic\_dry_t + \beta_7 * VIX_t + \varepsilon_{i,t}$$

[8] Primary energy is the energy available as resources – such as the fuels burnt in power plants – before it has been transformed. See https://ourworldindata.org/grapher/fossil-fuels-share-energy

Where i = a country and t = time, with $t = 1, 2, 3,\ldots T$ denoting the month.

Table 2. Variable definitions

Variable type	Variable name	Description	Frequency	Source
Dependent	Stock index national	Stock data on national indices	monthly	LSEG database
Dependent	Stock index sectoral	Stock data on global sectoral indices (i.e. IT, Healthcare, Energy, Utilities, Industrials and Materials)	monthly	LSEG database
Independent	Climate policy uncertainty index (CPU)	Based on news articles in eight leading US newspapers containing pre-specified climate related keywords	monthly	Gavriilidis (2021)
Independent	Environmental policy stringency index (PSI)	Country-specific and internationally comparable measure of the stringency of the environmental policy	yearly	OECD
Independent	Fossil fuel per capita	Average consumption of energy from coal, oil and gas, in kilowatt-hours per person	yearly	ourworldindata.org
Independent	Share of primary energy consumption from fossil fuels	Measured as percentage of primary energy	yearly	ourworldindata.org
Independent	media coverage	Media attention for subject 'climate change'. Measured by deviding # of climate related news articles by # non-climate related news articles	yearly	Factiva + author created
Independent	natural dissasters *occurrence*	Occurrence of natural dissasters classified *geophysical or hydrological*	monthly	emdat.be
Independent	natural dissasters *duration*	Duration of natural dissasters classified *climatological or meteorological*	monthly	emdat.be
Independent	elite cues / Google Trends data	(Proxy) measure of attention towards climate change	monthly	Google Trends data + author created
Control	Gold price	Gold price	monthly	LSEG database
Control	VIX index	Index representing the market its expectation of 30-day forward-looking volatility	monthly	Yahoo finance
Control	BEX-RAI index	Time-varying risk aversion index	monthly	nancyxu.net
Control	Baltic dry index	Index tracking rates for ships ferrying dry bulk commodoties	monthly	investing.com
Control	GDP	Annual growth rate of a country its gross domestic product (GDP)	yearly	data.worldbank.org
Control	Inflation rate (CPI)	Annual inflation rate (CPI) of a country	yearly	data.worldbank.org

3.2 Methodology

For the empirical analysis I used monthly stock index returns, both national and sectoral, as the dependent variable. Given the yearly frequency of several independent – and control variables (see Table 2) I conducted a Reversed Unrestricted Mixed Data Sampling Regression (RU-MIDAS) (Foroni et al., 2018). The RU-MIDAS can be used for producing forecasts of high frequency variables that also incorporate low frequency information (Foroni et al., 2018). To achieve this, the variables with a yearly frequency are lagged to match the monthly variables, in this process I forward-filled the *NA* values resulting from the lagged yearly variables. This results in the following baseline model to analyse the impact of CPU on a country its national stock index:

$$Stock\_nat_{i,t} = \beta_0 + \beta_1 * CPU_t + \beta_2 * X_{i,t} + \varepsilon_{i,t} \tag{1}$$

Where *i* is a country, *t* is time an *X* represents the control variables. The dependent variable is defined as the return of the country's benchmark index where $r_t = \frac{(p_t - p_{t-1})}{p_{t-1}}$, with *t* = 1, 2, 3,…*T* denoting the month and $\varepsilon_{i,t}$ being the error term.

To examine the effect of CPU on a country its specific sectoral indices, the baseline regression was adjusted as follows:

$$Utilities\_stock_{i,t} = \beta_0 + \beta_1 * CPU_t + \beta_2 * X_{i,t} + \varepsilon_{i,t} \tag{2}$$

$$Energy\_stock_{i,t} = \beta_0 + \beta_1 * CPU_t + \beta_2 * X_{i,t} + \varepsilon_{i,t} \tag{3}$$

$$Industrials\_stock_{i,t} = \beta_0 + \beta_1 * CPU_t + \beta_2 * X_{i,t} + \varepsilon_{i,t} \tag{4}$$

$$Materials\_stock_{i,t} = \beta_0 + \beta_1 * CPU_t + \beta_2 * X_{i,t} + \varepsilon_{i,t} \tag{5}$$

$$IT\_stock_{i,t} = \beta_0 + \beta_1 * CPU_t + \beta_2 * X_{i,t} + \varepsilon_{i,t} \tag{6}$$

$$Healthcare\_stock_{i,t} = \beta_0 + \beta_1 * CPU_t + \beta_2 * X_{i,t} + \varepsilon_{i,t} \tag{7}$$

Here, the dependent variable is defined in a similar manner as before in the baseline model, however, now as the return of a sector specific index (see appendix A). Equation (2) and (3) testing for capital-intensive sectors, equation (3), (4) and (5) testing for dirty sectors (because of the energy sector being both dirty and capital-intensive), equation (6) and (7) testing for R&D intensive sectors. All with *i* = a country and *t* = time, with *t* = 1, 2, 3,…*T* denoting the month and $\varepsilon_{i,t}$ being the error term. Sector classification (i.e. dirty, capital intensive and R&D intensive) has been conducted base on OECD reports in combination with the MSCI GICS methodology (Galindo-Rueda et al., 2016; OECD, 2024; MSCI, 2024).

To estimate the moderating effect of a country experiencing extreme weather events on the relation between CPU and national stock index returns, the following regression was conducted:

$$Stock\_nat_{i,t} = \beta_0 + \beta_1 * CPU_t + \beta_2 * Clima\_dur_{i,t} + \beta_3 * Meteo\_dur_{i,t} + \beta_4 * GEO\_bin_{i,t} + \beta_5 * Hydro\_bin_{i,t} + \beta_6 * (CPU_t * Clima\_dur_{i,t}) + \beta_7 * (CPU_t * Meteo\_dur_{i,t}) + \beta_8 * (CPU_t * GEO\_bin_{i,t}) + \beta_9 * (CPU_t * Hydro\_bin_{i,t}) + \beta_{10} * X_{i,t} + \varepsilon_{i,t} \quad (8)$$

Where in addition to the baseline model, *Clima_dur* and *Meteo_dur* represent the duration of climatological disasters and meteorological disasters respectively. As binary variables, *GEO_bin* and *Hydro_bin* represent the occurrence of a geophysical and a hydrological disaster respectively. The interaction terms *CPU*Clima_dur*, *CPU*Meteo_dur*, *CPU*GEO_bin* and *CPU*Hydro_bin* capture the moderating effect. All variables involved were centred before interacting to make interpretation more meaningful and reduce multicollinearity between main – and interaction effects. All with *i* = a country and *t* = time, with *t* = 1, 2, 3,…*T* denoting the month and $\varepsilon_{i,t}$ being the error term (see Appendix B).

To analyse the effect of climate related media coverage and elite cues, the following two regression were conducted:

$$Stock\_nat_{i,t} = \beta_0 + \beta_1 * CPU_t + \beta_2 * Media\_cov\_lagged_{i,t} + \beta_3 * (CPU_t * Media\_cov\_lagged_{i,t}) + \beta_4 * X_t + \varepsilon_{i,t} \quad (9)$$

$$Stock\_nat_{i,t} = \beta_0 + \beta_1 * CPU_t + \beta_2 * EPSI\_lagged_{i,t} + \beta_3 * Gtrends_{i,t} + \beta_4 * (CPU_t * EPSI_{i,t}) + \beta_5 * (CPU_t * Gtrends_{i,t}) + \beta_6 * X_t + \varepsilon_{i,t} \quad (10)$$

In equation (9) *Media_cov* and in equation (10) *EPSI* are lagged because of the RU-MIDAS regression. Where, prior to being lagged, $Media\_cov_{i,t} = \frac{Climate\ related\ articles_{i,t}}{NON\ Climate\ related\ articles_{i,t}}$. The interaction terms *CPU*Media_cov_lagged*, *CPU*EPSI* and *CPU*Gtrends* capture the moderating effect. All variables involved were centred before interacting to make interpretation more meaningful and reduce multicollinearity between main – and interaction effects. All with *i* = a country and *t* = time, with *t* = 1, 2, 3,…*T* denoting the month for both *Media_cov* and *EPSI* and $\varepsilon_{i,t}$ being the error term.

Finally, to estimate the effect a country its fossil fuel dependence on the relation between CPU and national stock index returns, the following was conducted:

$$Stock\_nat_{i,t} = \beta_0 + \beta_1 * CPU_t + \beta_2 * Foss\_capita\_lagged_{i,t} + \beta_3 * perc\_foss\_ener\_cons\_lagged_{i,t} + \beta_4 * (CPU_t * Foss\_capita\_lagged_{i,t}) + \beta_5 * (CPU_t * perc\_foss\_ener\_cons\_lagged_{i,t}) + \beta_6 * X_{i,t} + \varepsilon_{i,t} \quad (11)$$

Where *Foss_capita* and *perc_foss_ener_cons* are lagged as a result of the RU-MIDAS regression. *Foss_capita* reporting the per capita fossil fuel energy consumtion in kWh and *perc_foss_ener_cons* the share of primary energy consumption from fossil fuels. The interaction terms *CPU*Foss_capita_lagged* and *CPU*perc_foss_ener_cons_lagged* capture the moderating effect. All variables involved were centred before interacting to make interpretation more meaningful and reduce multicollinearity between main – and interaction effects. All with i = a country and t = time, with t = 1, 2, 3,…T denoting the month and $\varepsilon_{i,t}$ being the error term.

To perform the regressions, coding language R was used. All regressions are performed for all 33 countries individually.

4. Results & discussion

4.1 Baseline results and discussion

Figure 2 reports the results of the RU-MIDAS regression testing the effect of CPU on the returns of national stock indices.

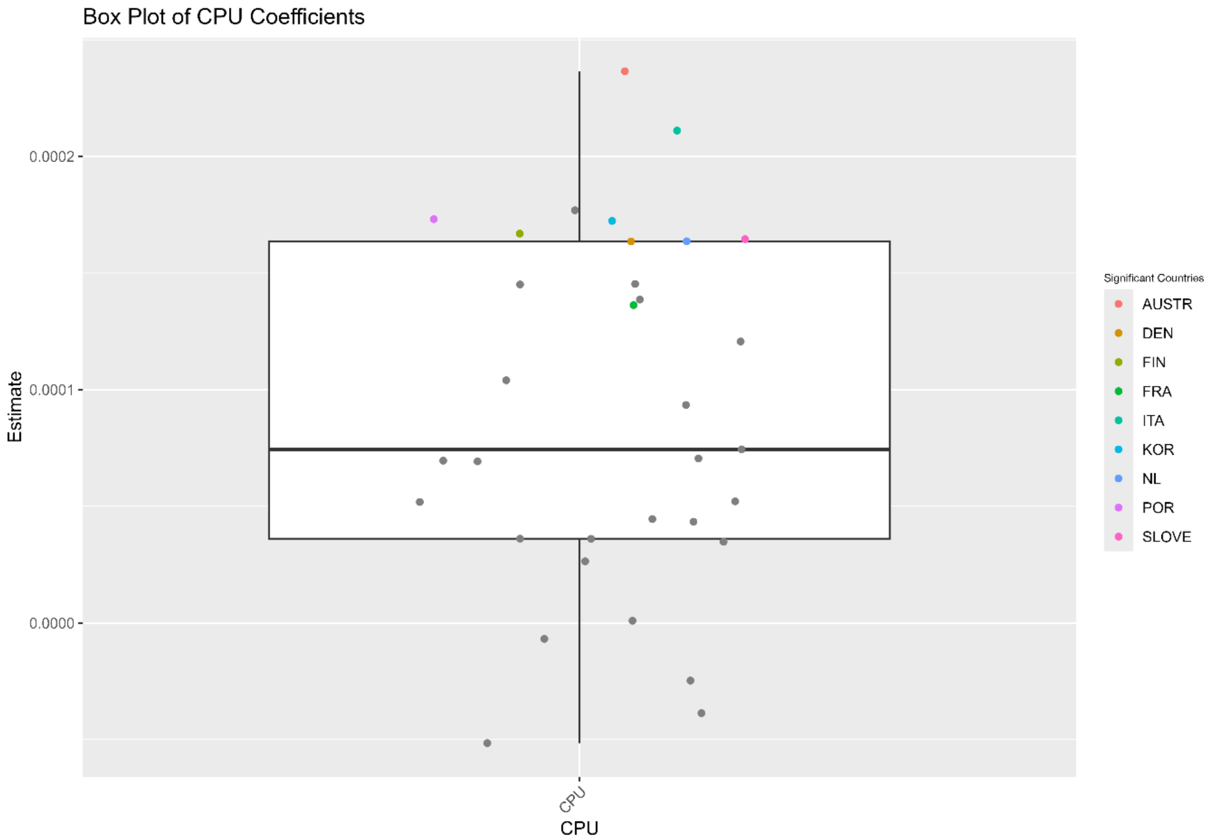

Figure 2. Box Plot of CPU coefficients for equation 1

Note: Significant coefficients were given a color and the corresponding country code is mentioned in the legend. Austria*, Denmark*, Finland*, France*, Italy*, Korea*, The Netherlands*, Portugal* and Slovenia*; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (See supplemental file *Regression Tables: A*).

These results are in line with prior research, as they are not fully conclusive on the direction of the effect of CPU on national stock index returns. Consistent with research from Batten et al. (2016) and He et al. (2020), the output shows negative and positive coefficients respectively, contradicting the hypothesized negative effect of CPU.

Generally, the results indicate that CPU does not affect national stock index returns all that much, given the small range in which the coefficients operate. The divergence in direction suggests that the effect of CPU is highly dependent on country specific factors such as the economic structure, regulatory environment, and technical capabilities.

However small, figure 2 shows positive significant effects of CPU for nine countries (i.e. Austria, Denmark, Finland, France, Italy, Korea, The Netherlands, Portugal, and Slovenia). These cases suggest that higher CPU index values correlate with higher stock returns in the national indices of the respective countries. A common denominator between most of these countries is their EU membership which imposes very stringent climate policies (e.g. The Green Deal & The Paris Agreement). Moreover, most possess leading positions in the climate transition and often have highly innovative energy sectors. The Netherlands for example, is known for its innovative solutions in renewable energy, including offshore wind farms[9]. Furthermore, many of these countries are known for their highly ambitious climate goals. Finland for instance, aims to be the first developed country to reach net zero in 2035 (Ministry of Finance Finland, n.d.). Besides just aims, France was one of the first countries to pass a binding climate law[10], which is favorable because governments tend to abolish climate policies of previous governments (Syed et al., 2023). Moreover, these countries often have a large part of their 'energy-mix' coming from renewable energy. In the case of Portugal, 95% of their energy mix comes from renewables[11]. Finally, apart from only their EU membership, most of these countries (i.e. Austria, Denmark, Finland, France, Italy, The Netherlands, Portugal, and Slovenia) are part of the Green Growth Group[12]. An informal grouping of 15 like-minded climate ministers working together to achieve a highly ambitious climate agenda.

It appears that their leading role in the climate transition makes these countries more adaptable to CPU and therewith provides these countries with opportunities rather than challenges. This reasoning is consistent with research from Bai et al. (2023) which claims CPU contributes to firms' green innovation and Tedeschi et al. (2024) who showed a positive impact of CPU on clean energy stock prices in Europe.

4.2 Sectoral differences and discussion

Figure 3 shows the results for the RU-MIDAS regression estimating the effect of CPU on capital intensive sector indices (i.e. energy and utilities). Contrary to the hypothesized negative relation between CPU and the returns of capital-intensive sectoral indices, the results show no significant effect of CPU on returns in the utilities sector across all 33 countries.

[9] See https://www.government.nl/topics/renewable-energy/offshore-wind-energy
[10] See https://www.vie-publique.fr/loi/23814-loi-energie-et-climat-du-8-novembre-2019
[11] See https://www.euronews.com/green/2024/05/10/renewables-are-meeting-95-of-portugals-electricity-needs-how-did-it-become-a-european-lead
[12] See https://www.government.nl/topics/climate-change/eu-policy

Additionally, even more contradicting, figure 3 and figure 4 show, however small, a positive significant effect of CPU on dirty sector index returns (i.e. energy -, materials - and industrials sector) for multiple countries. Although these results are counterintuitive and not expected in theory, this paradoxical relation could be depicting a problematic reality.

When we address firms within these dirty and capital-intensive sectors, we are often talking about large companies which are interrelated with the rest of the economy (Sen et al., 2020). According to research from Sen et al. (2020) this size and interrelation may lead to policy makers deeming energy companies in general “too big to fail”. They argue that therefore policymakers may opt for compensating policies, and that investors expect them to do so. Compensation then becomes a self-fulfilling prophecy. Because if investors expect these compensations, the same compensations then will be required to prevent a large downward shock, the researchers claim. Hence, compensating policies potentially make it more difficult to detect a significant effect of CPU on these firms.

Such a mechanism is supported by the consensus on lobbying power of firms within dirty sectors. Prior research illustrates that climate lobbying is big business, especially for firms in the transportation, utility, and fossil fuel sectors (Brulle, 2018). The same paper shows that the levels of lobbying are driven by the salience of pending legislation, indicating that CPU is also very likely to cause increased lobbying. This line of reasoning is consistent with findings from Lantushenko and Schellhorn (2023), whose results show that companies experiencing a stronger decrease in stock value when there is more negative climate-related news, are more likely to start lobbying and alongside have higher lobbying expenditures.

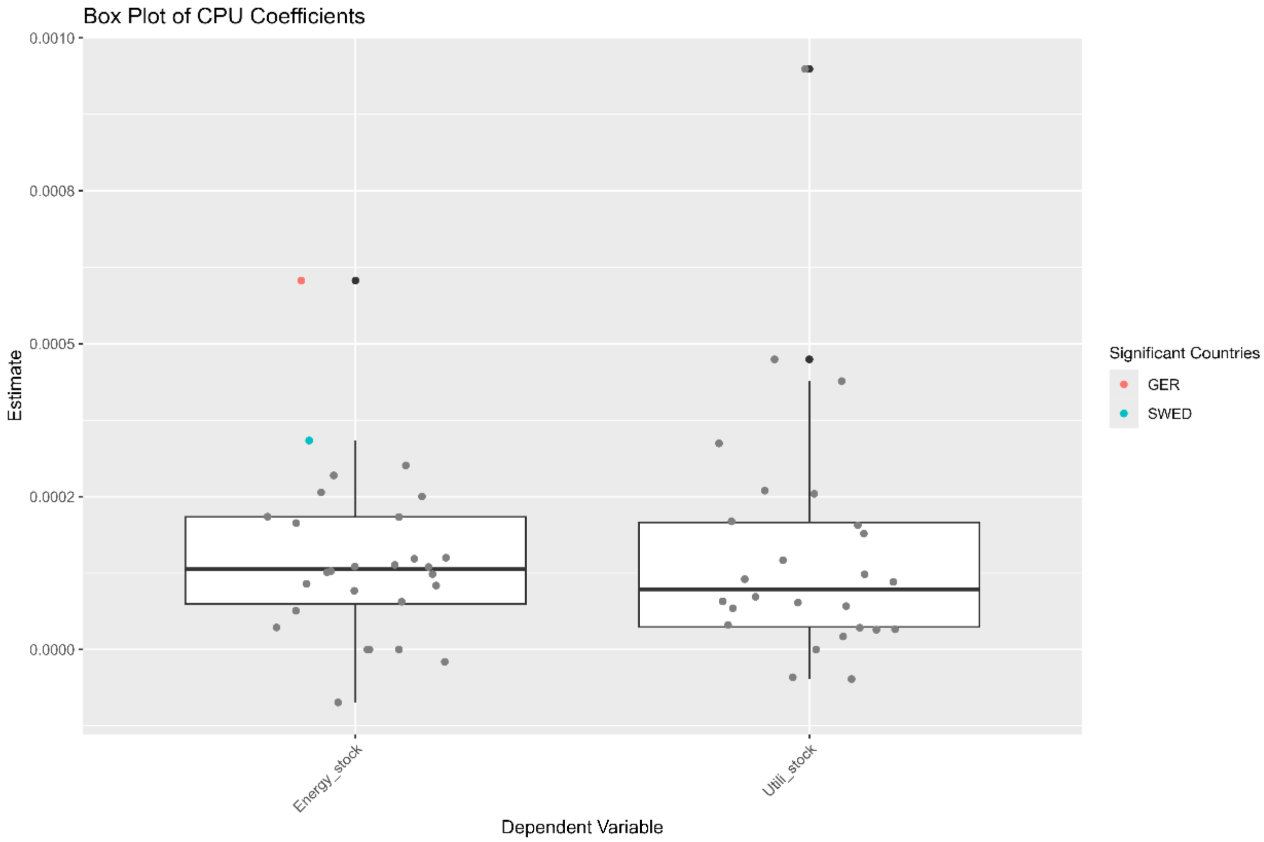

Figure 3. Box Plot of CPU coefficients for equation 2 and 3

Note: Dependent variables are *Energy_stock* and *Utili_stock*. Significant coefficients were given a color and the corresponding country code is mentioned in the legend. Germany(*Energy_stock*)** and Sweden(*Energy_stock*)*; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (See supplemental file *Regression Tables: B&C*). For better visualization the insignificant coefficient of Denmark (-0.0015) was dropped.

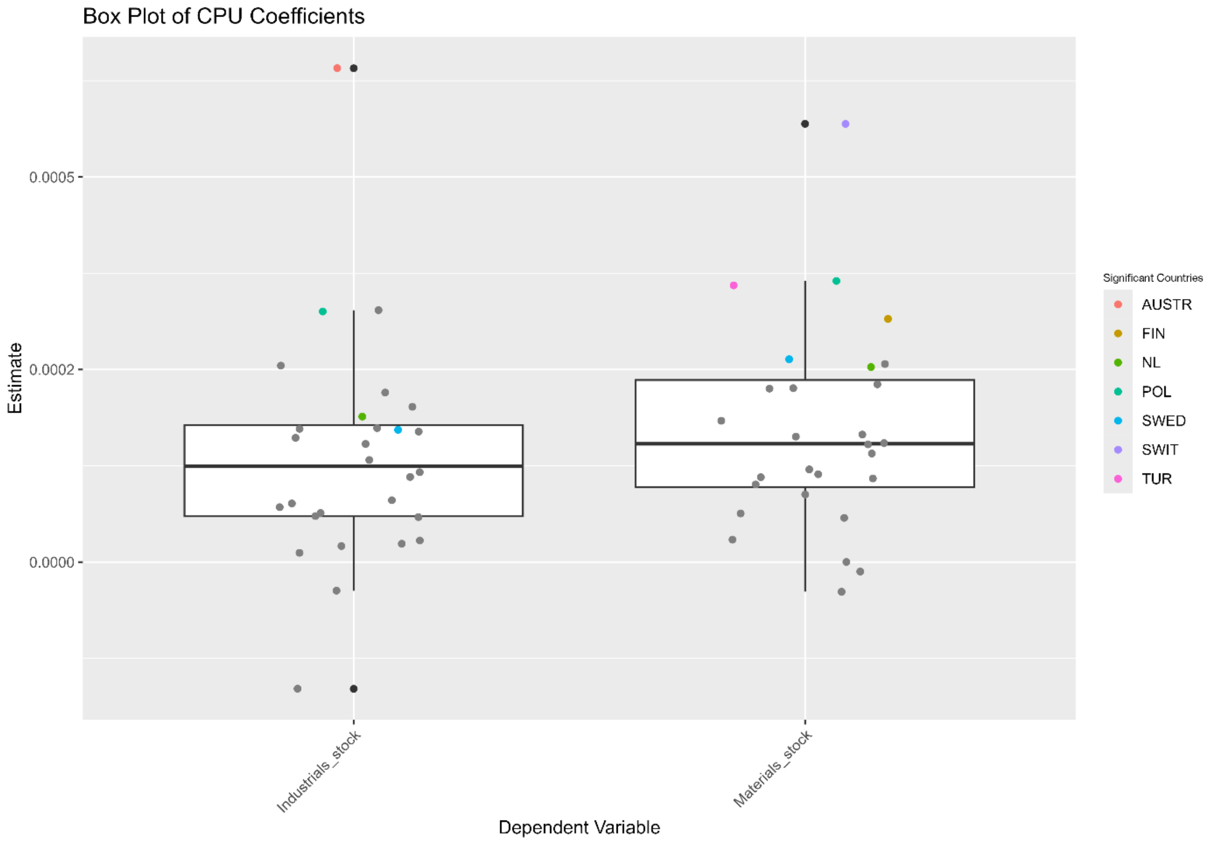

Figure 4. Box Plot of CPU coefficients for equation 4 and 5

Note: Dependent variables are *Industrials_stock* and *Materials_stock*. Significant coefficients were given a color and the corresponding country code is mentioned in the legend. Austria(*Industrials_stock*)*, Finland(*Materials_stock*)*, The Netherlands(*Industrials_stock** & *Materials_stock* **), Poland(*Industrials_stock** & *Materials_stock* *), Sweden(*Industrials_stock** & *Materials_stock* *), Switzerland(*Materials_stock*)* and Turkey(*Materials_stock*)*; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (See supplemental file *Regression Tables: D&E*).

Figure 5 shows the RU-MIDAS regression results for R&D intensive sectors (i.e. Healthcare and IT). Again, the results show a divergence in the effect of CPU between countries, underlining the lack of an internationally generalizable effect of CPU.

Further, slim positively significant effects of CPU are found for countries like the ones in our baseline regression results (see Figure 2). These findings contradict the hypothesized negative effect of CPU on these R&D intensive sectors, though this once more confirms the findings from Atanassov et al. (2015), which claim that governmental policy uncertainty encourages firms to use their R&D funds more efficient. Moreover, these results extend these findings by showing a similar effect for CPU.

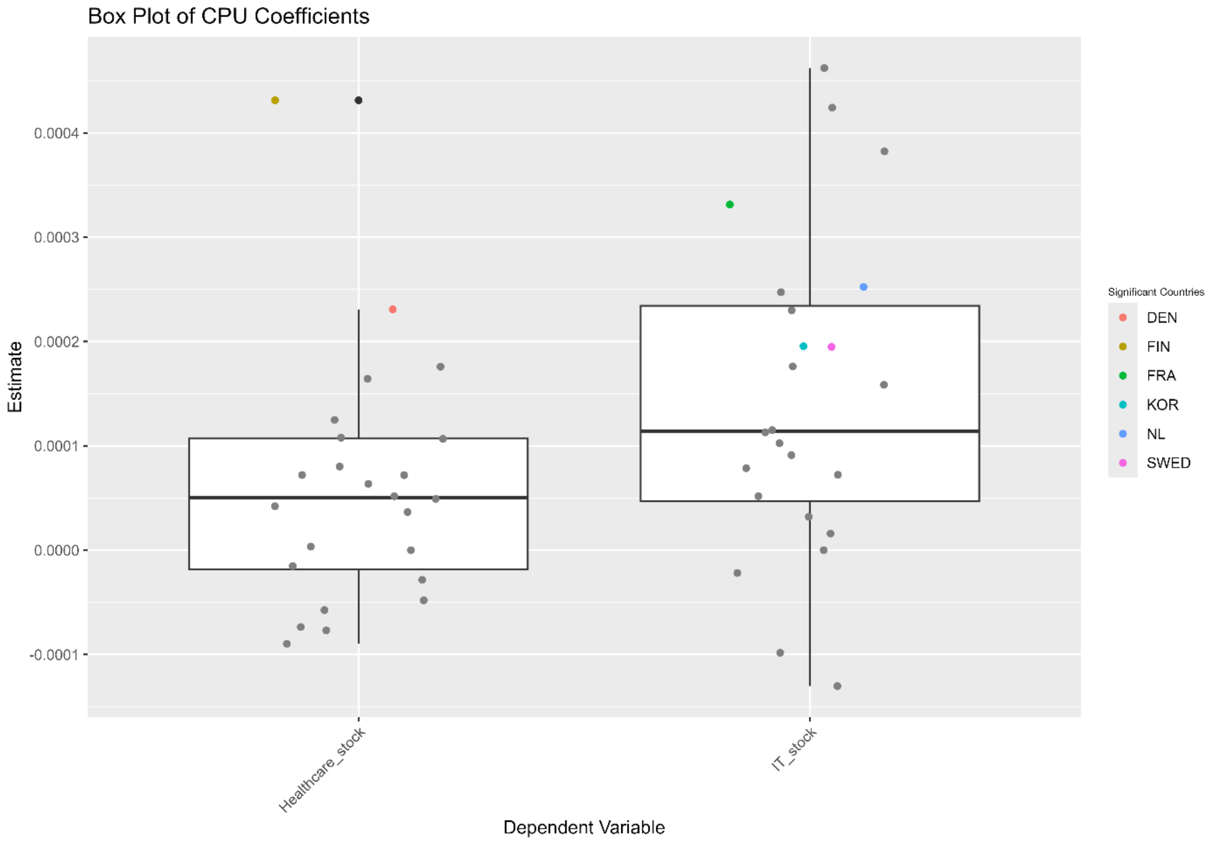

Figure 5. Box Plot of CPU coefficients for equation 6 and 7

Note: Dependent variables are *IT_stock* and *Healthcare_stock*. Significant coefficients were given a color and the corresponding country code is mentioned in the legend. Denmark(*Healthcare_stock*)*, Finland(*Healthcare_stock*)**, France(*IT_stock*)**, Korea(*IT_stock*)*, The Netherlands(*IT_stock*)* and Sweden(*IT_stock*)*; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (See supplemental file *Regression Tables: F&G*). For better visualization the insignificant coefficient of Ireland (Healthcare; -0.0017) was dropped.

4.3 Extreme weather events results and discussion

To resemble the moderating effect of a country its exposure to extreme weather on the relation between CPU and national stock index returns, Figure 6, 7, 8 and 9 show the interaction of *CPU* with *Clima_dur*, *GEO_bin, Meteo_dur* and *Hydro_bin* respectively (see Appendix B). Although, it was hypothesized that experience with extreme weather events would have a moderating effect on the relationship between CPU and national stock index returns, the results tell another story. For none of the 33 countries a significant effect was found for Climatological disasters (see Figure 6). For the other 3 disaster types only for a handful of countries a small significant effect was found (see Figure 7, 8 and 9).

These unexpected findings could however, be explained by the reasoning in earlier mentioned research from Carmichael and Brulle (2016). Contrary to the academic consensus (e.g. Weber, 2010; Keller et al., 2006; Taylor et al., 2014a) , they find that weather events in themselves have little influence on the overall public concern of climate change. They argue that their findings differ from the consensus, because they focus, similarly to this research, on a larger jurisdiction. According to them it is not likely that local weather events impact national opinion. This is a potential explanation of why no noteworthy significant national effect was found.

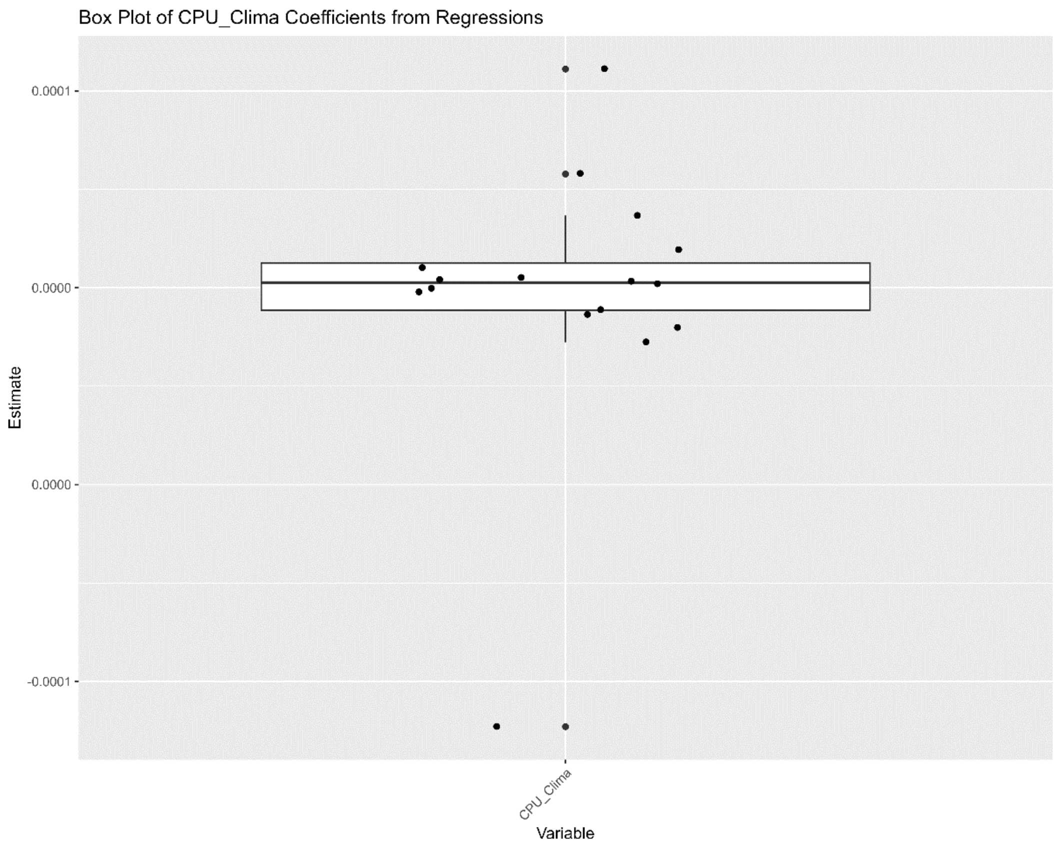

Figure 6. Box Plot of interaction term coefficients of CPU and Clima_dur for equation 8

Note: (See supplemental file *Regression Tables: H*).

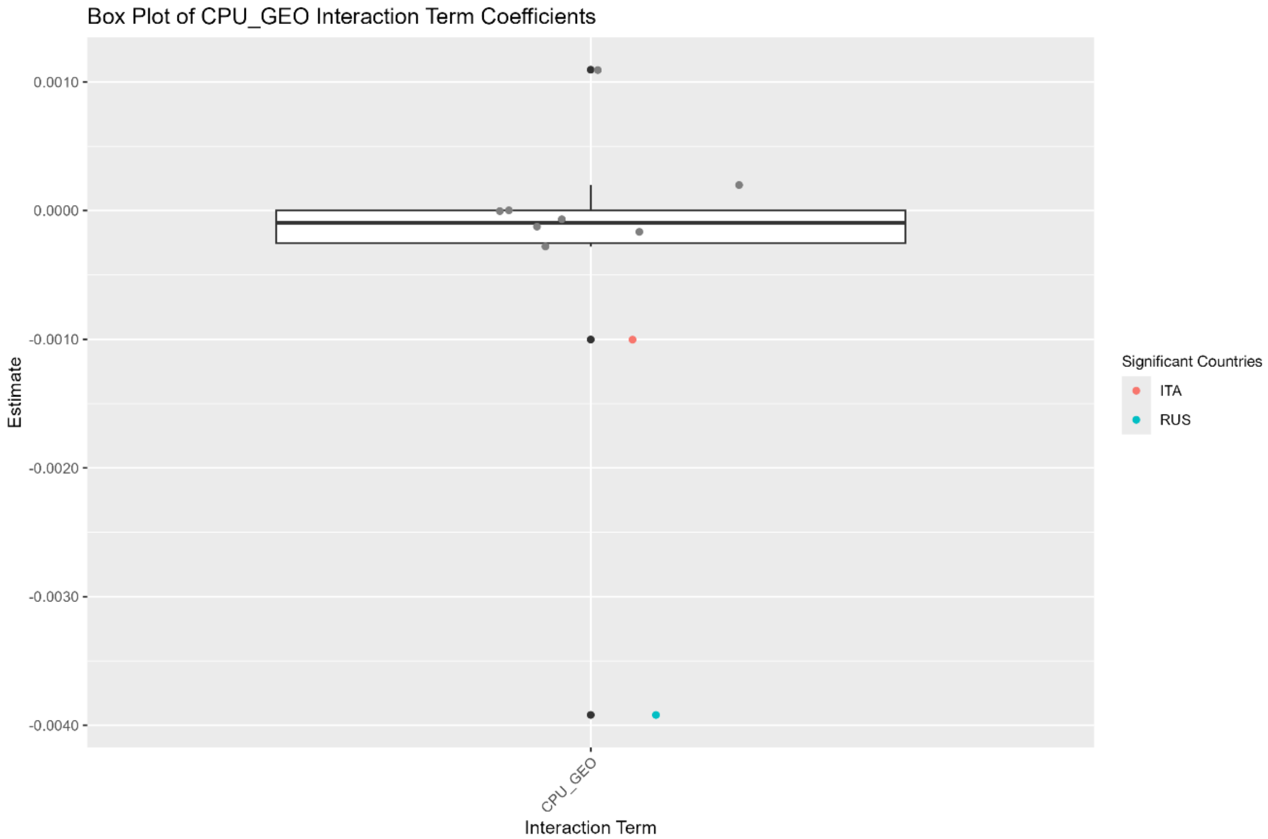

Figure 7. Box Plot of interaction term coefficients of CPU and GEO_bin for equation 8

Note: Significant coefficients were given a color and the corresponding country code is mentioned in the legend. Italy* and Russia**; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (See supplemental file *Regression Tables: H*).

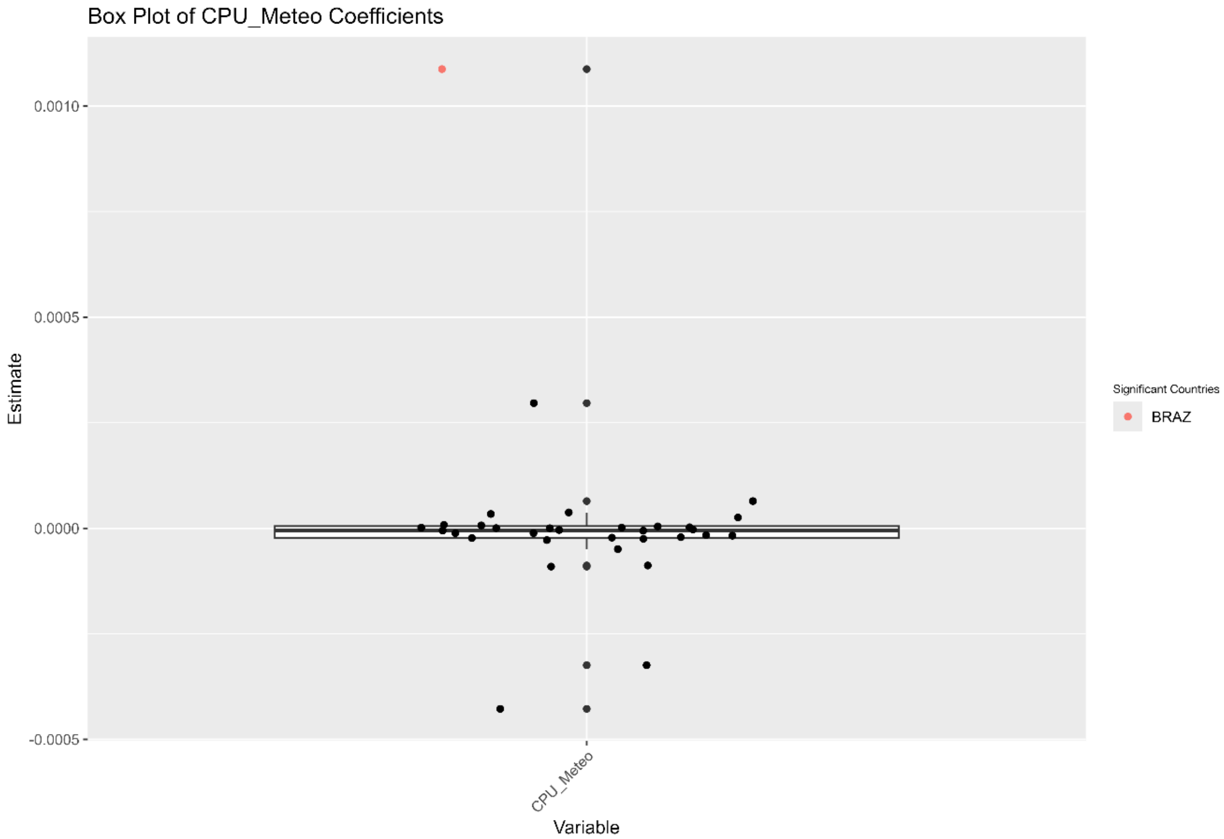

Figure 8. Box Plot of interaction term coefficients of CPU and Meteo_dur for equation 8

Note: Significant coefficients were given a color and the corresponding country code is mentioned in the legend. Brazil*; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (See supplemental file *Regression Tables: H*).

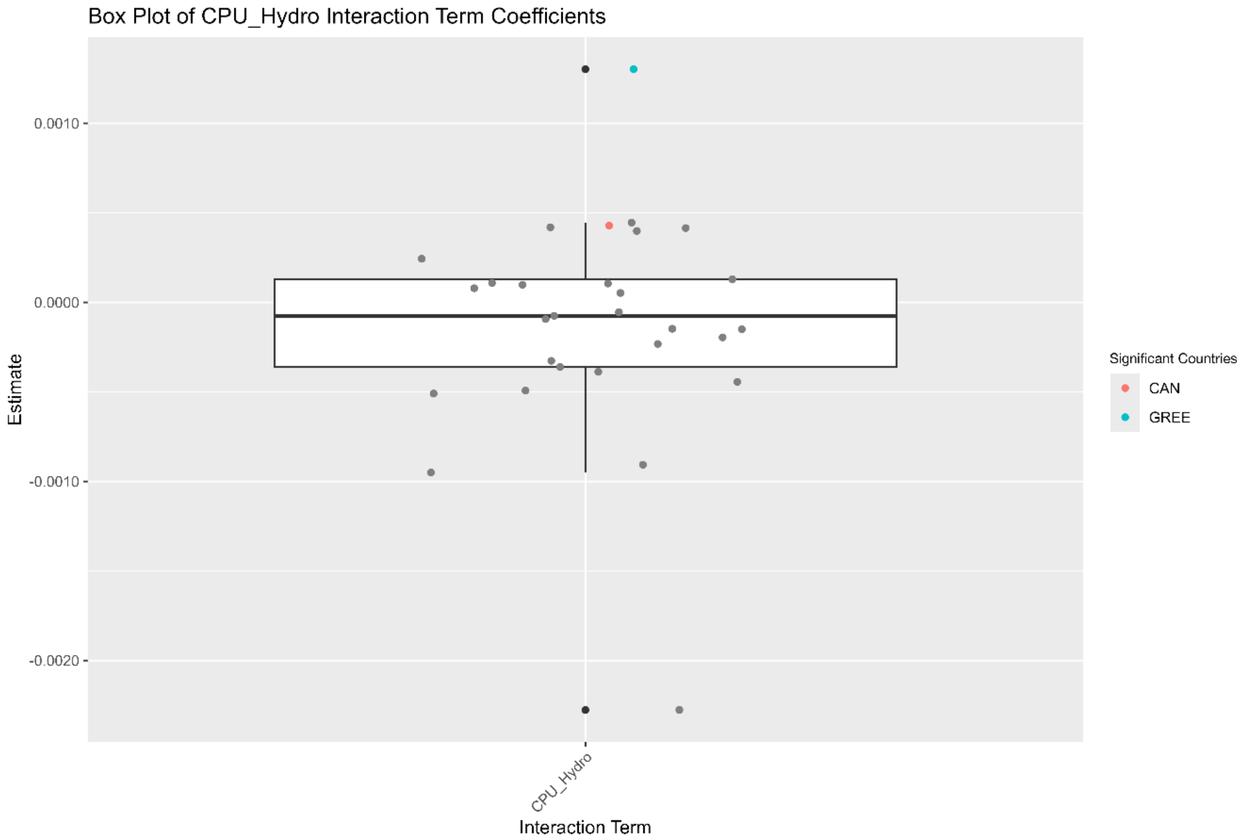

Figure 9. Box Plot of interaction term coefficients of CPU and Hydro_bin for equation 8

Note: Significant coefficients were given a color and the corresponding country code is mentioned in the legend. Canada* and Greece*; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (See supplemental file *Regression Tables: H*).

4.4 Media coverage results and discussion

The results in Figure 10 show the interaction between CPU and Media coverage to capture the moderating effect of the latter. For most countries, no presence was found of the hypothesized moderating effect of climate related media coverage on the relation between CPU and the returns on national stock indices. Apart from Greece, Slovenia, Turkey, and the US. For these countries a positive significant effect was found, implying that as the focus of media shifts more towards climate-related news, the impact of CPU on national stock index returns becomes larger.

These findings partly support prior research from Carmichael and Brulle (2016) claiming media coverage directly impacts public concern. There is no general direction or significance in the results, showing once again that significance is highly likely to be caused by country specific factors.

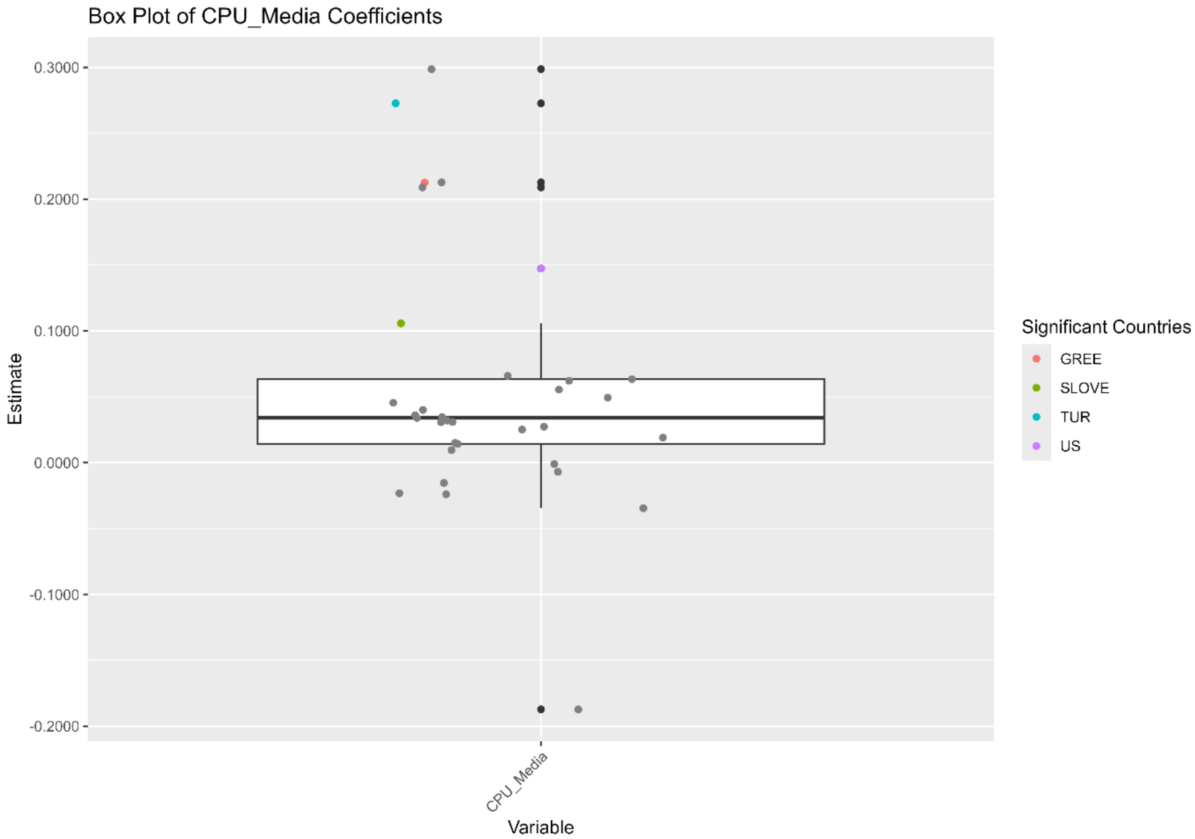

Figure 10. Box Plot of interaction term coefficients of CPU and Media_cov for equation 9

Note: Significant coefficients were given a color and the corresponding country code is mentioned in the legend. Greece*, Slovenia**, Turkey* and the US*; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (See supplemental file *Regression Tables: I*).

4.5 Elite cues results and discussion

Prior research (Ockwell et al., 2009; Feldman et al., 2015) address the importance of government policy regarding climate change, and Carmichael and Brulle (2016) even claim that elite cues are the most important factor when it comes to influencing the public opinion on climate change. As priorly discussed, combining the EPSI and the GTKI approximates the effect of elite cues. The rationale behind this is comparable with that of Carmichael and Brulle (2016). Environmental policies are typically formed by governments, reflecting the political elite in the form of the EPSI. And, investor attention often follows from elite discussions. Therefore, higher investor attention, measured through the Google Trends keyword data, indicates heightened cues from financial elites.

The results in Figure 11 show, contrary to the hypothesized moderating effect of elite cues, no distinctive direction nor general significance. Only for Korea a small positive significant effect was found. Altogether, this indicates that financial elite cues do not have a significant effect on the relation between CPU and national stock index returns.

The inability to find a significant effect might partly be caused by limitations in the GTKI. Although it could be expected that world its financial elites operate, mainly, using the English language, the GTKI did not consider other languages and might therefore be unable to capture the comprehensive effect a multi-lingual GTKI might be able to capture.

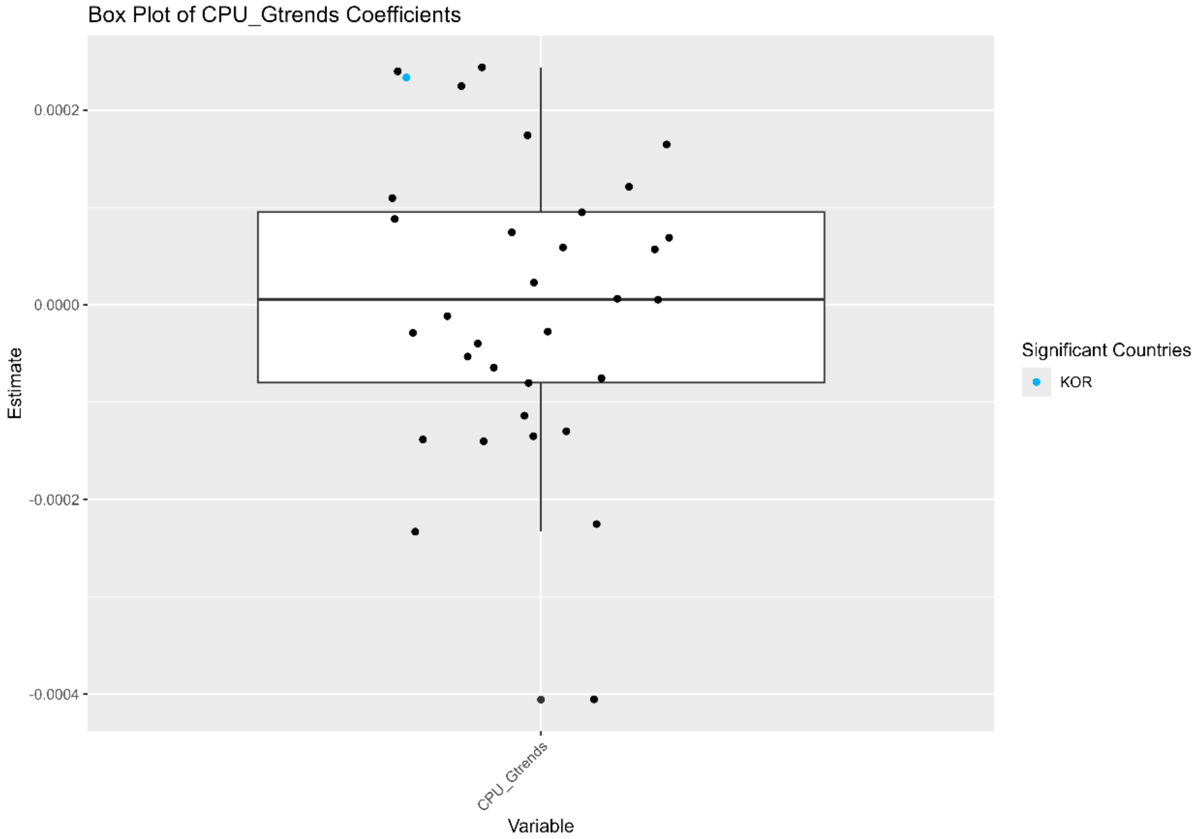

Figure 11. Box Plot of interaction term coefficients of CPU and Gtrends for equation 10

Note: Significant coefficients were given a color and the corresponding country code is mentioned in the legend. Korea*; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (See supplemental file *Regression Tables: J*).

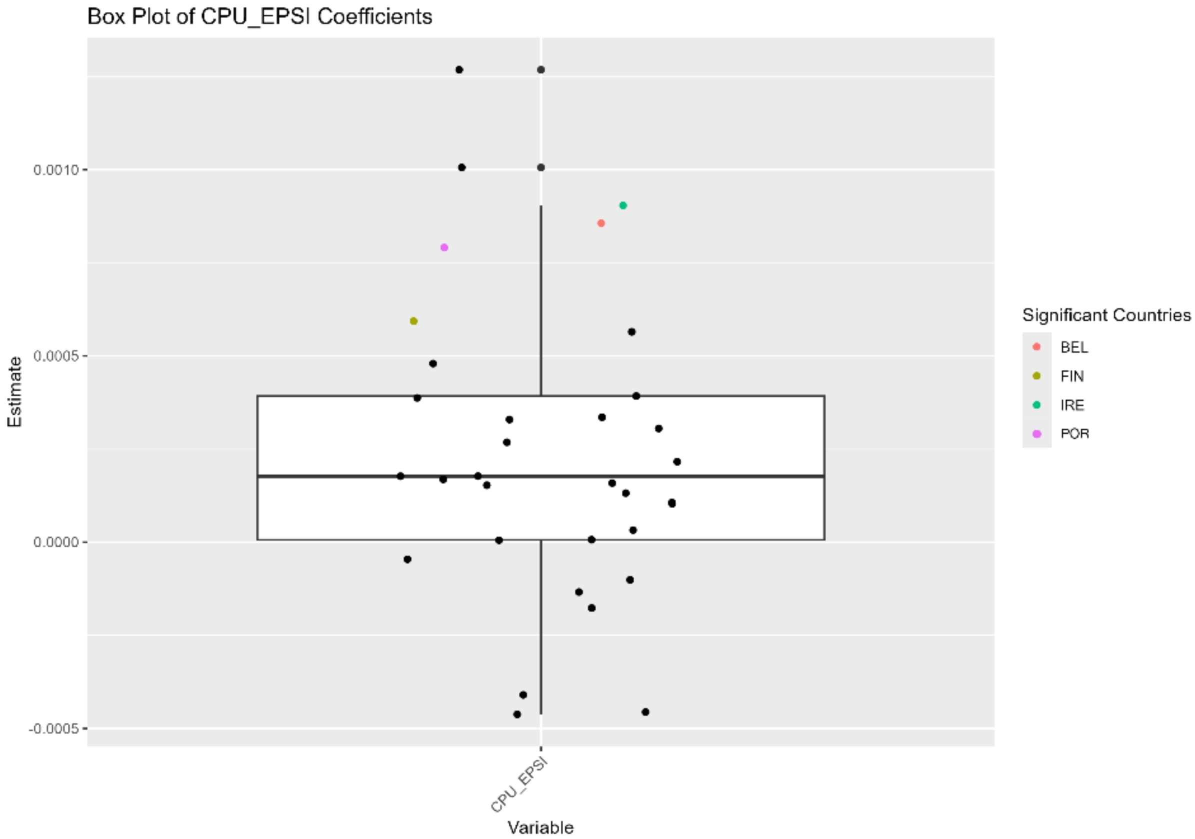

Figure 12. Box Plot of interaction term coefficients of CPU and EPSI for equation 10

Note: Significant coefficients were given a color and the corresponding country code is mentioned in the legend. Belgium*, Finland*, Ireland* and Portugal*; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (See supplemental file *Regression Tables: J*).

Figure 12 on the other hand, shows, however small, multiple positive significant values. These results indicate that for countries with more stringent environmental policies, CPU has a stronger positive effect on national stock index returns. Here, it once more stands out that the common denominator for these countries is their EU membership, supporting the earlier mentioned reasoning for our baseline regression results (see Figure 2).

Additionally, a visual inspection of the EPSI (see Appendix D) shows that the countries for which a significant positive effect was found in the baseline regression, often appear in the top five countries with the highest EPSI score between the years 2003 and 2020. Specifically, Denmark 15 times, Finland 8 times, France 16 times, Italy 7 times, The Netherlands and Korea both 3 times. This again supports the reasoning corresponding with the baseline results that countries with stringent policies and ambitious climate targets experience a positive effect of CPU (e.g. Tedeschi et al., 2024).

4.6 Fossil fuel dependence results and discussion

Finally, the results of the moderating effect of a country its fossil fuel dependence is shown in Figure 13 and Figure 14. Prior research from Ide (2020) identifies fossil fuel dependence as a key condition for countries with insufficient contributions to the Paris Agreement. Implicating that countries dependent on fossil fuels are less likely to see climate change as a threat (World Risk Poll, 2021). Therefore, it was hypothesized that fossil fuel dependency would have a moderating effect on the relation between CPU and the returns of national stock indices.

The results in figure 13 and figure 14 on the other hand, show no clear direction of the moderating effect and neither does it show clear significance. The effects are figure 13 are, however significant for Austria, Czechia, Japan, and Russia, tremendously small (i.e. coefficients of the CPU*EPSI interaction between -0.0000002 and 0.0000002), and therefore not noteworthy. Figure 14 shows similar small results, reporting less countries for which significance was found. So nonetheless prior expectations, the results show no moderating effect of a country its dependency on fossil fuels.

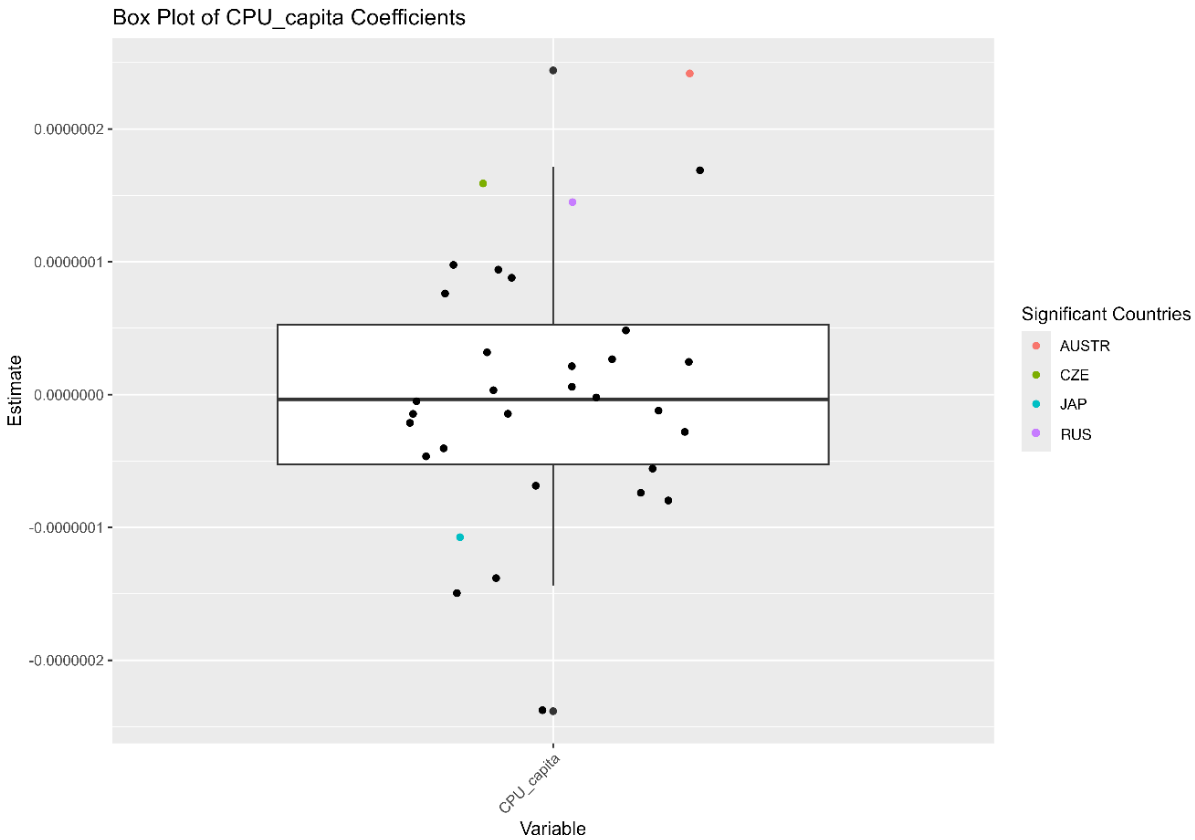

Figure 13. Box Plot of interaction term coefficients of CPU and Foss_capita for equation 11

Note: Significant coefficients were given a color and the corresponding country code is mentioned in the legend. Austria*, Czechia*, Japan* and Russia*; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (See supplemental file *Regression Tables: K*).

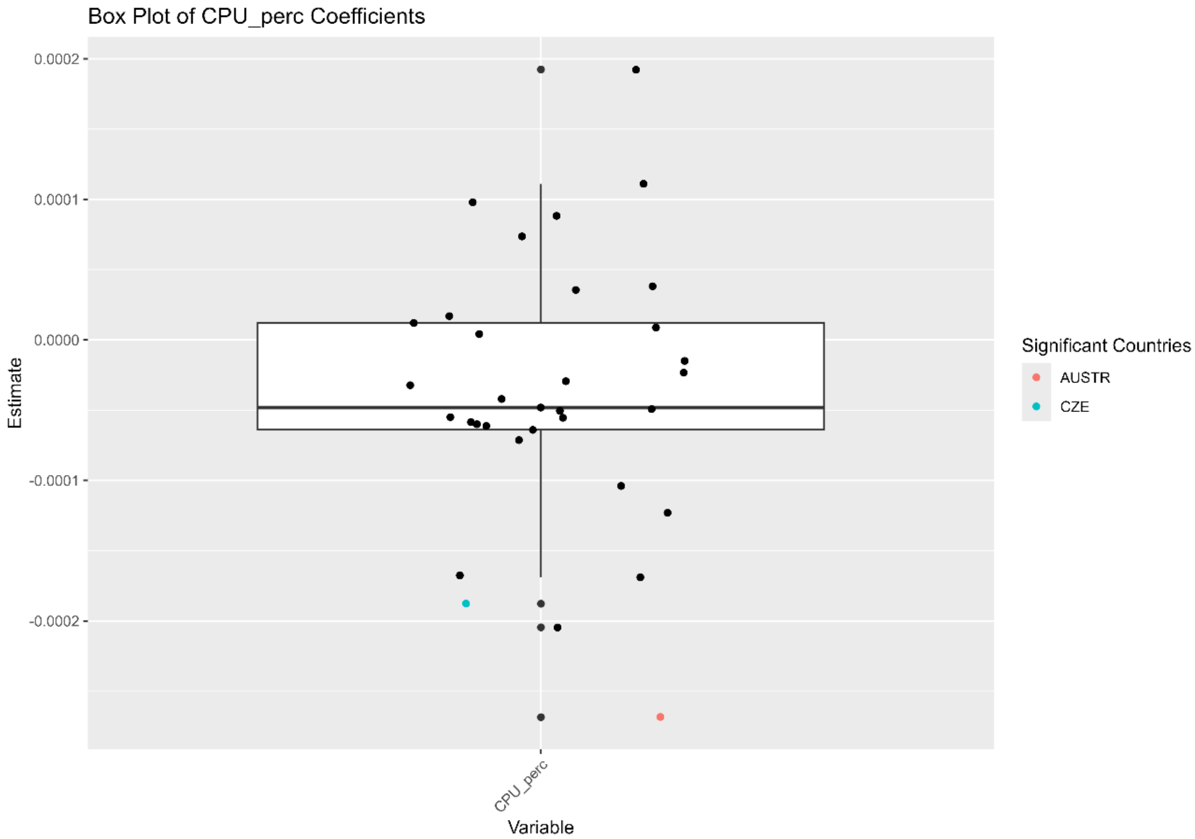

Figure 14. Box Plot of interaction term Coefficient of CPU and Perc_foss_ener_cons for equation 11

Note: Significant coefficients were given a color and the corresponding country code is mentioned in the legend. Austria* and Czechia*; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (See supplemental file *Regression Tables: K*).

5. Conclusion

This research aimed to identify the relation of climate policy uncertainty (CPU) on stock performance, highlighting national – and sectoral differences. I resorted to the CPU dataset by Gavriilidis (2021) and to capture national and sectoral differences, I used data on sectoral indices, media coverage, elite cues, fossil fuel dependency and natural disasters. Due to differences in variable frequency, a Reversed Unrestricted Mixed Data Sampling (RU-MIDAS) regression was used, allowing mixed data frequencies. The analysis was conducted for 33 countries ranging from 2004 to 2020.

Based on the results of the regression the following conclusions are drawn. Firstly, it can be concluded that in general the effect of CPU relatively insignificant when holding it against national stock index returns. The results show mostly small coefficients with a divergence in the direction of the effect and no consistent significance.

Secondly, when addressing national – and sectoral difference, the results also showed divergence and no consistent significance. This indicates that, in general, the effect of CPU depends on a country specific set of factors and cannot be attributed solely to either sectoral differences, media coverage, elite cues, fossil fuel dependence or the occurrence of extreme weather events. Although no general effect was found, the results of several countries showed significant effects for specific moderators.

The results did show however, a cohesion between most of the countries for which CPU was found to be positively significant (i.e. Austria, Denmark, Finland, France, Italy, Korea, The Netherlands, Portugal, and Slovenia). Besides their EU membership, known for their stringent climate policies, being a common denominator, most of these countries also participate in the Green Growth Group, an informal group within the EU known for their climate advocacy and ambitious climate goals.

This suggests that being a front runner in the climate transition (i.e. stringent policies and ambitious targets) leads to countries being more adaptable to CPU. Visual inspection of the environmental policy stringency index (EPSI), supports this line of reasoning by showing a prolonged presence of these countries, for which a positive significant effect of CPU was found, in the top-5 most stringent countries within a given year.

First, this research adds to the existing academic literature on the policy uncertainty topic by once more confirming the divergence in effects of CPU. Further, it underlines the fact that this divergence cannot be attributed to sectoral – or national differences in general and that it is highly likely a country specific combination of factors driving it. Moreover, it adds to the growing body of literature around the effect of climate (policies) on financial markets worldwide. Also, for policymakers these insights are useful, now knowing the importance of identifying the combination of factors affecting the relation between CPU and stock returns in their country, and not expecting a one-sided effect.

Furthermore, countries for which positive significance was found, should consider the economic effects the influence of CPU has in general or on sectors specifically.

This study is not without limitations. A more granular analysis of disaster events can be conducted, diving deeper into the effect of different climate events within the used categories. Also, for the GTKI, different weights could have been assigned to the keyword ideally based on a principal component analysis. Apart from that, all keywords used were English and therefore not always corresponding with national languages. Given the helicopter view analysis of this research, a more in-depth analysis was out of scope. Delving deeper into the effect of a EU membership alongside a Green Growth Group membership and other potentially mitigated country specific factors deserves further interest in future research.

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Appendix A

Global Industry Classification Sector (GICS)

Definitions of GICS Sectors effective close of March 17, 2023 (MSCI, 2023)

Energy Sector: The Energy Sector comprises companies engaged in exploration & production, refining & marketing, and storage & transportation of oil & gas and coal & consumable fuels. It also includes companies that offer oil & gas equipment and services.

Materials Sector: The Materials Sector includes companies that manufacture chemicals, construction materials, forest products, glass, paper and related packaging products, and metals, minerals and mining companies, including producers of steel.

Industrials Sector: The Industrials Sector includes manufacturers and distributors of capital goods such as aerospace & defense, building products, electrical equipment and machinery and companies that offer construction & engineering services. It also includes providers of commercial & professional services including printing, environmental and facilities services, office services & supplies, security & alarm services, human resource & employment services, research & consulting services. It also includes companies that provide transportation services.

Consumer Discretionary Sector: The Consumer Discretionary Sector encompasses those businesses that tend to be the most sensitive to economic cycles. Its manufacturing segment includes automobiles & components, household durable goods, leisure products and textiles & apparel. The services segment includes hotels, restaurants, and other leisure facilities. It also includes distributors and retailers of consumer discretionary products.

Consumer Staples Sector: The Consumer Staples Sector comprises companies whose businesses are less sensitive to economic cycles. It includes manufacturers and distributors of food, beverages and tobacco and producers of non-durable household goods and personal products. It also includes distributors and retailers of consumer staples products including food & drug retailing companies.

Health Care Sector: The Health Care Sector includes health care providers & services, companies that manufacture and distribute health care equipment & supplies, and health care technology companies. It also includes companies involved in the research, development, production and marketing of pharmaceuticals and biotechnology products. Financials Sector: The Financials Sector contains companies engaged in banking, financial services, consumer finance, capital markets and insurance activities. It also includes Financial Exchanges & Data and Mortgage REITs. Information

Technology Sector: The Information Technology Sector comprises companies that offer software and information technology services, manufacturers and distributors of technology hardware & equipment such as communications equipment, cellular phones, computers & peripherals, electronic equipment and related instruments, and semiconductors and related equipment & materials.

Communication Services Sector: The Communication Services Sector includes companies that facilitate communication and offer related content and information through various mediums. It includes telecom and media & entertainment companies including producers of interactive gaming products and companies engaged in content and information creation or distribution through proprietary platforms.

Utilities Sector: The Utilities Sector comprises utility companies such as electric, gas and water utilities. It also includes independent power producers & energy traders and companies that engage in generation and distribution of electricity using renewable sources.

Real Estate Sector: The Real Estate Sector contains companies engaged in real estate development and operation. It also includes companies offering real estate related services and Equity Real Estate Investment Trusts (REITs).

Table A 1. Global Industry Classification Sector (GICS)

Country	Sector	Provider	Ticker LSEG	Variant	Extra
Australia					
	Energy	MSCI	.MIAU0EN00PAU	Price	
	Materials	MSCI	.MIAU0MT00PAU	Price	
	Industrials	MSCI	.MIAU0IN00PAU	Price	
	Consumer discretionary	MSCI	.MIAU0CD00PAU	Price	
	Consumer Staples	MSCI	.dMIAU0CSI0PUS	Price	
	Health Care	MSCI	.MIAU0HC00PAU	Price	
	Financials	MSCI	.dMIAU0FNI0PUS	Price	
	Information Technology	MSCI	.MIAU0ITI0PAU	Price	
	Communication Services	MSCI	.MIAU0TC00PAU	Price	
	Utilities	MSCI	.MIAU0UT00PAU	Price	
	Real Estate	MSCI	.dMIAU0RSS0P	Price	Small cap
Austria					
	Energy	MSCI	.dMIAT0ENL0PUS	Price	Large cap
	Materials	MSCI	.dMIAT0MT00PUS	Price	
	Industrials	MSCI	.dMIAT0INI0PUS	Price	
	Consumer discretionary	MSCI	.MIAT0CD00PEU	Price	
	Consumer Staples	MSCI	.dMIAT0CSD0N	Net	Small + Mid cap
	Health Care	MSCI	.dMIAT0HCD0N	Net	Small + Mid cap
	Financials	MSCI	.dMIAT0FN00PUS	Price	
	Information Technology	MSCI	.dMIAT0ITI0PUS	Price	
	Communication Services	MSCI	.MIAT0TC00PEU	Price	
	Utilities	MSCI	.dMIAT0UTI0PUS	Price	
	Real Estate	MSCI	.dMIAT0RSS0P	Price	Small cap

Belgium					
	Energy	MSCI	.dMIBE0ENS0PUS	Price	Small cap
	Materials	MSCI	.dMIBE0MTS0PUS	Price	Small cap
	Industrials	MSCI	.dMIBE0INS0PUS	Price	Small cap
	Consumer discretionary	MSCI	.dMIBE0CD00P	Price	
	Consumer Staples	MSCI	.MIBE0CS00PEU	Price	
	Health Care	MSCI	.dMIBE0HCS0PUS	Price	Small cap
	Financials	MSCI	.dMIBE0FNS0PUS	Price	Small cap
	Information Technology	MSCI	.dMIBE0ITS0PUS	Price	Small cap
	Communication Services	MSCI	.dMIBE0TCS0PUS	Price	Small cap
	Utilities	MSCI	.dMIBE0UTS0PUS	Price	Small cap
	Real Estate	MSCI	.dMIBE0RSS0PUS	Price	Small cap
Brazil					
	Energy	MSCI	.MIBR0EN00PUS	Price	
	Materials	MSCI	.MIBR0MT00PUS	Price	
	Industrials	MSCI	.MIBR0IN00PUS	Price	
	Consumer discretionary	MSCI	.MIBR0CD00PUS	Price	
	Consumer Staples	MSCI	.MIBR0CS00PUS	Price	
	Health Care	MSCI	.MIBR0HC00PUS	Price	
	Financials	MSCI	.MIBR0FN00PUS	Price	
	Information Technology	MSCI	.MIBR0IT00PUS	Price	
	Communication Services	MSCI	.MIBR0TC00PUS	Price	
	Utilities	MSCI	.MIBR0UT00PUS	Price	
	Real Estate	MSCI	.dMIBR0RSS0PUS	Price	Small cap
Canada					
	Energy	MSCI	.MICA0ENI0PCA	Price	
	Materials	MSCI	.dMICA0MTS0PUS	Price	Small cap
	Industrials	MSCI	.dMICA0INS0PUS	Price	Small cap
	Consumer discretionary	MSCI	.dMICA0CDS0PUS	Price	Small cap
	Consumer Staples	MSCI	.dMICA0CSS0PUS	Price	Small cap
	Health Care	MSCI	.dMICA0HCS0P	Price	Small cap
	Financials	MSCI	.MICA0FN00NCA	Net	
	Information Technology	MSCI	.MICA0IT00PCA	Price	
	Communication Services	MSCI	.dMICA0TCS0P	Price	Small cap
	Utilities	MSCI	.dMICA0UTS0PUS	Price	Small cap
	Real Estate	MSCI	.dMICA0RSS0P	Price	Small cap
China					
	Energy	MSCI	.MICN0EN00PHK	Price	
	Materials	MSCI	.MICN0MT00PHK	Price	
	Industrials	MSCI	.MICN0IN00PHK	Price	
	Consumer discretionary	MSCI	.MICN0CD00PHK	Price	
	Consumer Staples	MSCI	.MICN0CS00PHK	Price	
	Health Care	MSCI	.MICN0HC00PHK	Price	
	Financials	MSCI	.MICN0FN00PHK	Price	
	Information Technology	MSCI	.MICN0IT00PHK	Price	
	Communication Services	MSCI	.MICN0TC00PHK	Price	
	Utilities	MSCI	.MICN0UT00PHK	Price	
	Real Estate	MSCI	.MICN0RE00PCN	Price	
Czechia					
	Energy	MSCI	.MICZ0EN00PCZ	Price	
	Materials	MSCI	.MICZ0MT00PCZ	Price	
	Industrials	MSCI	na		
	Consumer discretionary	MSCI	.dMICZ0CDS0PUS	Price	Small cap
	Consumer Staples	MSCI	.dMICZ0CSS0PUS	Price	Small cap
	Health Care	MSCI	.MICZ0HC00PCZ	Price	
	Financials	MSCI	.MICZ0FN00NCZ	Net	
	Information Technology	MSCI	.MICZ0IT00PCZ	Price	
	Communication Services	MSCI	.dMICZ0TCD0PUS	Price	Small + Mid cap
	Utilities	MSCI	.MICZ0UT00NCZ	Net	

	Real Estate	MSCI	na		
Denmark					
	Energy	MSCI	.MIDK0EN00PDK	Price	
	Materials	MSCI	.dMIDK0MT00PUS	Price	
	Industrials	MSCI	.dMIDK0IN00PUS	Price	
	Consumer discretionary	MSCI	.dMIDK0CDS0PUS	Price	Small cap
	Consumer Staples	MSCI	.dMIDK0CS00PUS	Price	
	Health Care	MSCI	.dMIDK0HC00PUS	Price	
	Financials	MSCI	.dMIDK0FN00P	Price	
	Information Technology	MSCI	.dMIDK0ITI0PUS	Price	
	Communication Services	MSCI	na		
	Utilities	MSCI	.MIDK0UT00PDK	Price	
	Real Estate	MSCI	.dMIDK0RSS0G	Price	Small cap
Finland					
	Energy	MSCI	.dMIFI0ENI0PUS	Price	
	Materials	MSCI	.dMIFI0MT00PUS	Price	
	Industrials	MSCI	.dMIFI0IN00P	Price	
	Consumer discretionary	MSCI	.dMIFI0CDS0PUS	Price	Small cap
	Consumer Staples	MSCI	.dMIFI0CSI0PUS	Price	
	Health Care	MSCI	.dMIFI0HC00PUS	Price	
	Financials	MSCI	.dMIFI0FN00PUS	Price	
	Information Technology	MSCI	.dMIFI0IT00PUS	Price	
	Communication Services	MSCI	.dMIFI0TC00PUS	Price	
	Utilities	MSCI	.dMIFI0UT00PUS	Price	
	Real Estate	MSCI	.dMIFI0RSS0PUS	Price	Small cap
France					
	Energy	MSCI	.MIFR0EN00PEU	Price	
	Materials	MSCI	.MIFR0MT00PEU	Price	
	Industrials	MSCI	.MIFR0IN00PEU	Price	
	Consumer discretionary	MSCI	.MIFR0CD00PEU	Price	
	Consumer Staples	MSCI	.MIFR0CS00PEU	Price	
	Health Care	MSCI	.MIFR0HC00PEU	Price	
	Financials	MSCI	.MIFR0FN00PEU	Price	
	Information Technology	MSCI	.dMIFR0IT00PUS	Price	
	Communication Services	MSCI	.MIFR0TC00PEU	Price	
	Utilities	MSCI	.MIFR0UT00PEU	Price	
	Real Estate	MSCI	.dMIFR0RSS0PUS	Price	Small cap
Germany					
	Energy	MSCI	.dMIDE0ENI0PUS	Price	
	Materials	MSCI	.MIDE0MT00GEU	Gross	
	Industrials	MSCI	.dMIDE0IN00P	Price	
	Consumer discretionary	MSCI	.MIDE0CD00PEU	Price	
	Consumer Staples	MSCI	.MIDE0CS00PEU	Price	
	Health Care	MSCI	.dMIDE0HC00P	Price	
	Financials	MSCI	.MIDE0FN00PEU	Price	
	Information Technology	MSCI	.MIDE0IT00PEU	Price	
	Communication Services	MSCI	.MIDE0TC00PEU	Price	
	Utilities	MSCI	.MIDE0UT00PEU	Price	
	Real Estate	MSCI	.dMIDE0RSS0PUS	Price	Small cap
Greece					
	Energy	MSCI	.dMIGR0ENI0PUS	Price	
	Materials	MSCI	.dMIGR0MTI0PUS	Price	
	Industrials	MSCI	.dMIGR0INI0PUS	Price	
	Consumer discretionary	MSCI	.dMIGR0CDI0PUS	Price	
	Consumer Staples	MSCI	.MIGR0CS00PEU	Price	
	Health Care	MSCI	.dMIGR0HCD0P	Price	Small + Mid cap
	Financials	MSCI	.dMIGR0FNI0PUS	Price	
	Information Technology	MSCI	.MIGR0IT00PEU	Price	
	Communication Services	MSCI	.dMIGR0TCI0PUS	Price	

	Utilities	MSCI	.dMIGR0UTI0PUS	Price	
	Real Estate	MSCI	.dMIGR0RSS0PUS	Price	Small cap
Hungary					
	Energy	MSCI	.MIHU0EN00PHU	Price	
	Materials	MSCI	.MIHU0MT00PHU	Price	
	Industrials	MSCI	.MIHU0IN00PHU	Price	
	Consumer discretionary	MSCI	na		
	Consumer Staples	MSCI	.MIHU0CS00PHU	Price	
	Health Care	MSCI	na		
	Financials	MSCI	.MIHU0FN00NHU	Net	
	Information Technology	MSCI	.MIHU0IT00PHU	Price	
	Communication Services	MSCI	na		
	Utilities	MSCI	na		
	Real Estate	MSCI	na		
India					
	Energy	MSCI	.MIIN0EN00PIN	Price	
	Materials	MSCI	.MIIN0MT00PIN	Price	
	Industrials	MSCI	.MIIN0IN00PIN	Price	
	Consumer discretionary	MSCI	.MIIN0CD00PIN	Price	
	Consumer Staples	MSCI	.MIIN0CS00PIN	Price	
	Health Care	MSCI	.MIIN0HC00PIN	Price	
	Financials	MSCI	.MIIN0FN00PIN	Price	
	Information Technology	MSCI	.MIIN0IT00PIN	Price	
	Communication Services	MSCI	.MIIN0TC00PIN	Price	
	Utilities	MSCI	.MIIN0UT00PIN	Price	
	Real Estate	MSCI	.dMIIN0RSS0PUS	Price	Small cap
Indonesia					
	Energy	MSCI	.MIID0EN00PID	Price	
	Materials	MSCI	.MIID0MT00GID	Gross	
	Industrials	MSCI	.MIID0IN00GID	Gross	
	Consumer discretionary	MSCI	.MIID0CD00GID	Gross	
	Consumer Staples	MSCI	.MIID0CS00GID	Gross	
	Health Care	MSCI	.MIID0HC00GID	Gross	
	Financials	MSCI	.MIID0FN00GID	Gross	
	Information Technology	MSCI	.dMIID0ITS0G	Price	Small cap
	Communication Services	MSCI	.MIID0TC00GID	Gross	
	Utilities	MSCI	.MIID0UT00PID	Price	
	Real Estate	MSCI	.dMIID0RE00PUS	Price	
Ireland					
	Energy	MSCI	.MIIE0EN00PEU	Price	
	Materials	MSCI	.dMIIE0MT00P	Price	
	Industrials	MSCI	.dMIIE0IN00P	Price	
	Consumer discretionary	MSCI	.dMIIE0CDI0PUS	Price	
	Consumer Staples	MSCI	.dMIIE0CS00P	Price	
	Health Care	MSCI	.dMIIE0HC00P	Price	
	Financials	MSCI	.dMIIE0FNI0PUS	Price	
	Information Technology	MSCI	.MIIE0IT00PEU	Price	
	Communication Services	MSCI	.MIIE0TC00PEU	Price	
	Utilities	MSCI	.MIIE0UT00PEU	Price	
	Real Estate	MSCI	.dMIIE0RSI0P	Price	
Italy					
	Energy	MSCI	.MIIT0EN00PEU		
	Materials	MSCI	.dMIIT0MTI0P	Price	
	Industrials	MSCI	.MIIT0IN00PEU	Price	
	Consumer discretionary	MSCI	.MIIT0CD00PEU	Price	
	Consumer Staples	MSCI	.dMIIT0CSI0PUS	Price	
	Health Care	MSCI	.dMIIT0HCI0PUS	Price	
	Financials	MSCI	.MIIT0FN00PEU	Price	
	Information Technology	MSCI	.dMIIT0ITI0PUS	Price	
	Communication Services	MSCI	.MIIT0TC00PEU	Price	

	Utilities	MSCI	.MIIT0UT00PEU	Price	
	Real Estate	MSCI	.dMIIT0REI0PUS	Price	
Japan					
	Energy	MSCI	.MIJP0EN00PJP	Price	
	Materials	MSCI	.MIJP0MT00PJP	Price	
	Industrials	MSCI	.MIJP0IN00PJP	Price	
	Consumer discretionary	MSCI	.MIJP0CD00PJP	Price	
	Consumer Staples	MSCI	.MIJP0CS00PJP	Price	
	Health Care	MSCI	.MIJP0HC00PJP	Price	
	Financials	MSCI	.MIJP0FN00PJP	Price	
	Information Technology	MSCI	.MIJP0IT00PJP	Price	
	Communication Services	MSCI	.MIJP0TC00PJP	Price	
	Utilities	MSCI	.MIJP0UT00PJP	Price	
	Real Estate	MSCI	.MIJP0RE00PJP	Price	
Korea					
	Energy	MSCI	.MIKR0ENI0GKR	Gross	
	Materials	MSCI	.MIKR0MTI0GKR	Gross	
	Industrials	MSCI	.MIKR0INI0GKR	Gross	
	Consumer discretionary	MSCI	.MIKR0CDI0GKR	Gross	
	Consumer Staples	MSCI	.MIKR0CSI0GKR	Gross	
	Health Care	MSCI	.MIKR0HCM0GKR	Gross	
	Financials	MSCI	.MIKR0FNI0GKR	Gross	
	Information Technology	MSCI	.MIKR0ITI0GKR	Gross	
	Communication Services	MSCI	.MIKR0TC00GKR	Gross	
	Utilities	MSCI	.MIKR0UT00GKR	Gross	
	Real Estate	MSCI	.dMIKR0RSS0G	Gross	Small cap
Netherlands					
	Energy	MSCI	.MINL0EN00PEU	Price	
	Materials	MSCI	.MINL0MT00PEU	Price	
	Industrials	MSCI	.MINL0IN00PEU	Price	
	Consumer discretionary	MSCI	.MINL0CD00PEU	Price	
	Consumer Staples	MSCI	.MINL0CS00PEU	Price	
	Health Care	MSCI	na		
	Financials	MSCI	.MINL0FN00PEU	Price	
	Information Technology	MSCI	.MINL0IT00PEU	Price	
	Communication Services	MSCI	.MINL0TC00PEU	Price	
	Utilities	MSCI	na		
	Real Estate	MSCI	.dMINL0RE00P	Price	
Norway					
	Energy	MSCI	.dMINO0EN00PUS	Price	
	Materials	MSCI	.dMINO0MT00PUS	Price	
	Industrials	MSCI	.dMINO0INI0PUS	Price	
	Consumer discretionary	MSCI	.dMINO0CDI0PUS	Price	
	Consumer Staples	MSCI	.dMINO0CSI0PUS	Price	
	Health Care	MSCI	.dMINO0HCS0P	Price	Small cap
	Financials	MSCI	.dMINO0FN00PUS	Price	
	Information Technology	MSCI	.dMINO0ITI0PUS	Price	
	Communication Services	MSCI	.dMINO0TC00PUS	Price	
	Utilities	MSCI	.dMINO0ULI0P	Price	
	Real Estate	MSCI	.dMINO0RSI0P	Price	
Poland					
	Energy	MSCI	.MIPL0EN00GPL	Gross	
	Materials	MSCI	.MIPL0MT00GPL	Gross	
	Industrials	MSCI	.dMIPL0INS0G	Gross	
	Consumer discretionary	MSCI	.MIPL0CD00GPL	Gross	
	Consumer Staples	MSCI	.MIPL0CS00GPL	Gross	
	Health Care	MSCI	.MIPL0HC00PPL	Price	
	Financials	MSCI	.MIPL0FN00PPL	Price	
	Information Technology	MSCI	.dMIPL0ITS0GUS	Gross	
	Communication Services	MSCI	.dMIPL0TCS0GUS	Gross	

	Utilities	MSCI	.MIPL0UT00GPL	Gross	
	Real Estate	MSCI	.dMIPL0RSS0G	Gross	Small cap
Portugal					
	Energy	MSCI	.dMIPT0EN00PUS	Price	
	Materials	MSCI	.dMIPT0MTI0PUS	Price	
	Industrials	MSCI	.dMIPT0INI0PUS	Price	
	Consumer discretionary	MSCI	.dMIPT0CDI0PUS	Price	
	Consumer Staples	MSCI	.dMIPT0CS00PUS	Price	
	Health Care	MSCI	.MIPT0HC00PEU	Price	
	Financials	MSCI	.dMIPT0FNI0PUS	Price	
	Information Technology	MSCI	.MIPT0IT00PEU	Price	
	Communication Services	MSCI	.dMIPT0TCS0P	Price	Small cap
	Utilities	MSCI	.dMIPT0UT00PUS	Price	
	Real Estate	MSCI	na		
Russia					
	Energy	MSCI	na		
	Materials	MSCI	na		
	Industrials	MSCI	na		
	Consumer discretionary	MSCI	na		
	Consumer Staples	MSCI	na		
	Health Care	MSCI	na		
	Financials	MSCI	na		
	Information Technology	MSCI	na		
	Communication Services	MSCI	na		
	Utilities	MSCI	na		
	Real Estate	MSCI	na		
Slovakia					
	Energy	MSCI	na		
	Materials	MSCI	na		
	Industrials	MSCI	na		
	Consumer discretionary	MSCI	na		
	Consumer Staples	MSCI	na		
	Health Care	MSCI	na		
	Financials	MSCI	na		
	Information Technology	MSCI	na		
	Communication Services	MSCI	na		
	Utilities	MSCI	na		
	Real Estate	MSCI	na		
Slovenia					
	Energy	MSCI	na		
	Materials	MSCI	na		
	Industrials	MSCI	na		
	Consumer discretionary	MSCI	na		
	Consumer Staples	MSCI	na		
	Health Care	MSCI	na		
	Financials	MSCI	na		
	Information Technology	MSCI	na		
	Communication Services	MSCI	na		
	Utilities	MSCI	na		
	Real Estate	MSCI	na		
South Africa					
	Energy	MSCI	.MIZA0EN00GZA	Gross	
	Materials	MSCI	.MIZA0MT00GZA	Gross	
	Industrials	MSCI	.MIZA0IN00GZA	Gross	
	Consumer discretionary	MSCI	.dMIZA0CDS0PUS	Price	Small cap
	Consumer Staples	MSCI	.dMIZA0CSS0PUS	Price	Small cap
	Health Care	MSCI	.dMIZA0HCS0PUS	Price	Small cap
	Financials	MSCI	.MIZA0FN00GZA	Gross	
	Information Technology	MSCI	.dMIZA0ITS0P	Price	Small cap
	Communication Services	MSCI	.MIZA0TC00GZA	Gross	

	Utilities	MSCI	.MIZA0UT00PZA	Price	
	Real Estate	MSCI	.dMIZA0RE00G	Gross	
Spain					
	Energy	MSCI	.MIES0EN00PEU	Price	
	Materials	MSCI	.dMIES0MTI0P	Price	
	Industrials	MSCI	.MIES0IN00PEU	Price	
	Consumer discretionary	MSCI	.MIES0CD00PEU	Price	
	Consumer Staples	MSCI	.dMIES0CSI0PUS	Price	
	Health Care	MSCI	.MIES0HC00PEU	Price	
	Financials	MSCI	.MIES0FN00PEU	Price	
	Information Technology	MSCI	.MIES0IT00PEU	Price	
	Communication Services	MSCI	.MIES0TC00PEU	Price	
	Utilities	MSCI	.MIES0UT00PEU	Price	
	Real Estate	MSCI	.dMIES0RSI0P	Price	
Sweden					
	Energy	MSCI	.MISE0EN00PSE	Price	
	Materials	MSCI	.dMISE0MT00P	Price	
	Industrials	MSCI	.dMISE0IN00P	Price	
	Consumer discretionary	MSCI	.dMISE0CD00P	Price	
	Consumer Staples	MSCI	.dMISE0CS00P	Price	
	Health Care	MSCI	.dMISE0HC00PUS	Price	
	Financials	MSCI	.dMISE0FN00P	Price	
	Information Technology	MSCI	.dMISE0IT00P	Price	
	Communication Services	MSCI	.dMISE0TC00P	Price	
	Utilities	MSCI	.MISE0UT00PSE	Price	
	Real Estate	MSCI	.dMISE0RSI0P	Price	
Switzerland					
	Energy	MSCI	.MICH0EN00PCH	Price	
	Materials	MSCI	.MICH0MT00PCH	Price	
	Industrials	MSCI	.MICH0IN00PCH	Price	
	Consumer discretionary	MSCI	.MICH0CD00PCH	Price	
	Consumer Staples	MSCI	.MICH0CS00PCH	Price	
	Health Care	MSCI	.MICH0HC00PCH	Price	
	Financials	MSCI	.dMICH0FN00PUS	Price	
	Information Technology	MSCI	.dMICH0ITI0PUS	Price	
	Communication Services	MSCI	.MICH0TC00PCH	Price	
	Utilities	MSCI	.dMICH0UTI0PUS	Price	
	Real Estate	MSCI	.dMICH0RSS0P	Price	Small cap
Turkey					
	Energy	MSCI	.MITR0EN00GTR	Gross	
	Materials	MSCI	.MITR0MT00GTR	Gross	
	Industrials	MSCI	.MITR0IN00GTR	Gross	
	Consumer discretionary	MSCI	.dMITR0CDS0PUS	Price	Small cap
	Consumer Staples	MSCI	.MITR0CS00GTR	Gross	
	Health Care	MSCI	.dMITR0HCS0P	Price	Small cap
	Financials	MSCI	.dMITR0FNS0PUS	Price	Small cap
	Information Technology	MSCI	.dMITR0ITI0PUS	Price	
	Communication Services	MSCI	.MITR0TC00GTR	Gross	
	Utilities	MSCI	.dMITR0UTS0G	Gross	
	Real Estate	MSCI	.dMITR0RSS0P	Price	Small cap
United Kingdom					
	Energy	MSCI	.dMIGB0ENI0PUS	Price	
	Materials	MSCI	.dMIGB0MT00P	Price	
	Industrials	MSCI	.dMIGB0IN00P	Price	
	Consumer discretionary	MSCI	.dMIGB0CD00P	Price	
	Consumer Staples	MSCI	.MIGB0CS00NGB	Net	
	Health Care	MSCI	.dMIGB0HC00PUS	Price	
	Financials	MSCI	.MIGB0FN00PGB	Price	
	Information Technology	MSCI	.MIGB0IT00PGB	Price	

	Communication Services	MSCI	.dMIGB0TC00PUS	Price	
	Utilities	MSCI	.MIGB0UT00NGB	Net	
	Real Estate	MSCI	.dMIGB0RDS0PUS	Price	Small cap
United States					
	Energy	MSCI	.MIUS0EN00PUS	Price	
	Materials	MSCI	.MIUS0MT00PUS	Price	
	Industrials	MSCI	.MIUS0IN00PUS	Price	
	Consumer discretionary	MSCI	.MIUS0CD00PUS	Price	
	Consumer Staples	MSCI	.MIUS0CS00PUS	Price	
	Health Care	MSCI	.MIUS0HC00PUS	Price	
	Financials	MSCI	.MIUS0FN00PUS	Price	
	Information Technology	MSCI	.MIUS0IT00PUS	Price	
	Communication Services	MSCI	.MIUS0TC00PUS	Price	
	Utilities	MSCI	.MIUS0UT00PUS	Price	
	Real Estate	MSCI	.MIUS0RE00PUS	Price	

Note: Table displays country, GICS sector, provider, ticker, variant and additional extra information.

Appendix B
Natural disaster types

This appendix consists of the disaster classifications (i.e. Climatological hazards[13], Geophysical hazards[14], Hydrological hazards[15] and Meteorological hazards[16]) of the data retrieved from the emdat.be database.

Table B 1. Climatological Hazards

Climatological Hazards	A hazard caused by long-lived, meso- to macro-scale atmospheric processes ranging from intra-seasonal to multi-decadal climate variability.
Drought	An extended period of unusually low precipitation that produces a shortage of water for people, animals, and plants. Drought is different from most other hazards in that it develops slowly, sometimes even over the years, and its onset is generally difficult to detect. Drought is not solely a physical phenomenon because its impacts can be exacerbated by human activities and water supply demands. Drought is therefore often defined both conceptually and operationally. Operational definitions of drought, i.e., the degree of precipitation reduction that constitutes a drought, vary by locality, climate, and environmental sector.
Glacial lake outburst flood	These floods occur when water held back by a glacier or moraine is suddenly released. Glacial lakes can be at the front of the glacier (marginal lake) or below the ice sheet (sub-glacial lake).
Wildfire	Any uncontrolled and non-prescribed combustion or burning of plants in a natural setting such as a forest, grassland, brush land or tundra, which consumes natural fuels and spreads based on environmental conditions (e.g., wind, or topography). Wildfires can be triggered by lightning or human actions.
Forest fire	A type of wildfire in a wooded area.
Land fire (Brush, Bush, Pasture)	A type of wildfire in a brush, bush, pasture, grassland, or other treeless natural environment.

[13] See https://doc.emdat.be/docs/data-structure-and-content/glossary/climatological-hazards/
[14] See https://doc.emdat.be/docs/data-structure-and-content/glossary/geophysical-hazards/
[15] See https://doc.emdat.be/docs/data-structure-and-content/glossary/hydrological-hazards/
[16] See https://doc.emdat.be/docs/data-structure-and-content/glossary/meteorological-hazards/

Table B 2. Geophysical Hazards

Geophysical hazard	**A hazard originating from solid earth. This term is used interchangeably with the term geological hazard.**
Earthquake	Sudden movement of a block of the Earth's crust along a geological fault and associated ground shaking.
Ground movement	Surface displacement of earthen materials due to ground shaking triggered by earthquakes or volcanic eruptions.
Tsunami	A series of waves (with long wavelengths when traveling across the deep ocean) that are generated by a displacement of massive amounts of water through underwater earthquakes, volcanic eruptions, or landslides. Tsunami waves travel at very high speed across the ocean, but as they begin to reach shallow water they slow down, and the wave grows steeper.
Mass movement (dry)	Any type of downslope movement of earth materials under hydrological dry conditions.
Avalanche (dry)	A large mass of loosened earth material, snow, or ice that slides, flows, or falls rapidly down a mountainside under the force of gravity. Debris Avalanche: The sudden and very rapid downslope movement of a mixed mass of rock and soil. There are two general types of debris avalanches. A cold debris avalanche usually results from an unstable slope suddenly collapsing whereas a hot debris avalanche results from volcanic activity leading to slope instability and collapse.
Landslide (dry)	Any kind of moderate to rapid soil movement incl. lahars, mudslides, and debris flows (under dry conditions). A landslide is the movement of soil or rock controlled by gravity and the speed of the movement usually ranges between slow and rapid, but it is not very slow. It can be superficial or deep, but the materials must make up a mass that is a portion of the slope or the slope itself. The movement has to be downward and outward with a free face.
Rockfall (dry)	N/A
Sudden subsidence (dry)	Sinking of the ground due to groundwater removal, mining, dissolution of limestone (e.g., karst sinkholes), extraction of natural gas, and earthquakes. In this case, the sinking occurs under dry conditions as a result of a geophysical trigger.
Volcanic activity	A type of volcanic event near an opening/vent in the Earth's surface including volcanic eruptions of lava, ash, hot vapor, gas, and pyroclastic material.
Ash fall	Fine (less than 4 mm in diameter) unconsolidated volcanic debris blown into the atmosphere during an eruption; can remain airborne for long periods of time and travel a considerable distance from the source.
Lava flow	The ejected magma that moves as a liquid mass downslope from a volcano during an eruption.
Pyroclastic flow	Extremely hot gases, ash, and other materials with a temperature of more than 1,000 degrees Celsius that rapidly flow down the flank of a volcano (at more than 700 km/h) during an eruption.
Lahar	Hot or cold mixture of earthen material flowing down the slope of a volcano either during or between volcanic eruptions.

Table B 3. Hydrological Hazards

Hydrological hazard	**A hazard caused by the occurrence, movement, and distribution of surface and subsurface freshwater and saltwater.**
Flood	A general term for the overflow of water from a stream channel onto normally dry land in the floodplain (riverine flooding), higher-than-normal levels along the coast (coastal flooding) and in lakes or reservoirs as well as ponding of water at or near the point where the rain fell (flash floods).
Coastal flood	Higher-than-normal water levels along the coast caused by tidal changes or thunderstorms that result in flooding, which can last from days to weeks.
Flash flood	Heavy or excessive rainfall in a short period of time that produces immediate runoff, creating flooding conditions within minutes or a few hours during or after the rainfall.
Riverine flood	A type of flooding resulting from the overflow of water from a stream or river channel onto normally dry land in the floodplain adjacent to the channel.
Ice jam flood	The accumulation of floating ice restricting or blocking a river's flow and drainage. Ice jams tend to develop near river bends and obstructions (e.g., bridges).
Mass movement (wet)	Types of mass movement that occur when heavy rain or rapid snow/ice melt send large amounts of vegetation, mud, or rock down a slope driven by gravitational forces.
Avalanche (wet)	A large mass of loosened earth material, snow, or ice that slides, flows, or falls rapidly down a mountainside under the force of gravity. Snow Avalanche: Rapid downslope movement of a mix of snow and ice.
Landslide (wet)	Any kind of moderate to rapid soil movement incl. lahars, mudslides, and debris flows (under wet conditions). A landslide is the movement of soil or rock controlled by gravity and the speed of the movement usually ranges between slow and rapid, but it is not very slow. It can be superficial or deep, but the materials must make up a mass that is a portion of the slope or the slope itself. The movement has to be downward and outward with a free face.
Rockfall (wet)	N/A
Sudden subsidence (wet)	Sinking of the ground due to groundwater removal, mining, dissolution of limestone (e.g., karst sinkholes), extraction of natural gas, and earthquakes. In this case, the sinking occurs under wet conditions as a result of a hydrological trigger (e.g., rain).
Mudslide	N/A
Wave action	Wind-generated surface waves that can occur on the surface of any open body of water such as oceans, rivers, or lakes. The size of the wave depends on the strength of the wind and the distance traveled (fetch).
Rogue wave	An unusual single crest of an ocean wave far out at sea that is much higher and/or steeper than other waves in the prevailing swell system.
Seiche	A standing wave of water in a large semi- or fully-enclosed body of water (lakes or bays) created by strong winds and/or a large barometric pressure gradient.

Table B 4. Meteorological Hazards

Meteorological hazard	**A hazard caused by short-lived, micro- to meso-scale extreme weather and atmospheric conditions that last from minutes to days.**
Extreme temperature	A general term for temperature variations above (extreme heat) or below (extreme cold) normal conditions.
Cold wave	A period of abnormally cold weather. Typically, a cold wave lasts for two or more days and may be aggravated by high winds. The exact temperature criteria for what constitutes a cold wave may vary by location.
Heat wave	A period of abnormally hot and/or unusually humid weather. Typically, a heat wave lasts for two or more days. The exact temperature criteria for what constitutes a heat wave may vary by location.
Severe winter conditions	Damage caused by snow and ice. Winter damage refers to damage to buildings, infrastructure, traffic (esp. navigation) inflicted by snow and ice in the form of snow pressure, freezing rain, frozen waterways etc.
Fog	Water droplets that are suspended in the air near the Earth’s surface. Fog is, in fact, simply a cloud that is in contact with the ground.
Storm	N/A
Derecho	Widespread and usually fast-moving windstorms associated with a convection/convective storm. Derechos include downburst and straight-line winds. The damage from derechos is often confused with the damage from tornadoes.
Hail	Solid precipitation in the form of irregular pellets or balls of ice more than 5 mm in diameter.
Lightning / Thunderstorms	A high-voltage, visible electrical discharge produced by a thunderstorm and followed by the sound of thunder.
Sand/Dust storm	Strong winds carrying particles of sand aloft, but generally confined to less than 50 feet (15 m), especially common in arid and semi-arid environments. A dust storm is also characterized by strong winds but carries smaller particles of dust rather than sand over an extensive area.
Storm surge	An abnormal rise in sea level generated by a tropical cyclone or other intense types of storm.
Tornado	A violently rotating column of air that reaches the ground or open water (waterspout).
Winter storm/Blizzard	A low-pressure system in winter months with significant accumulations of snow, freezing rain, sleet, or ice. A blizzard is a severe snowstorm with winds exceeding 35 mph (56 km/h) for three or more hours, producing reduced visibility (less than 0.25 miles (400 m)).
Extra-tropical storm	A type of low-pressure cyclonic system in the middle and high latitudes (also called a mid-latitude cyclone) that primarily gets its energy from the horizontal temperature contrasts (fronts) in the atmosphere. When associated with cold fronts, extra-tropical cyclones may be particularly damaging (e.g., European winter/windstorm, or Nor’easter).
Tropical cyclone	A tropical cyclone originates over tropical or subtropical waters. It is characterized by a warm-core, non-frontal synoptic-scale cyclone with a low-pressure center, spiral rain bands and strong winds. Depending on their location, tropical cyclones are referred to as hurricanes (Atlantic, Northeast Pacific), typhoons (Northwest Pacific), or cyclones (South Pacific and Indian Ocean).
Severe weather	N/A

Appendix C

Keyword and their corresponding weights used in the Google Trends keyword index (GTKI)

Table C 1. Keywords and their corresponding weights and justification

Keyword	Weight	Justification
Climate change	0.08	As the overarching theme, climate change is a critical keyword that captures general interest and attention (Brulle et al., 2012).
Climate policy	0.07	Climate policies are the core focus of this index and are expected to have a significant impact on investor attention (Monasterolo et al., 2017).
Climate finance	0.06	Climate finance is a key aspect of investor attention, as it directly relates to the flow of capital towards climate-related initiatives (Falcone & Sica, 2019).
Climate risk	0.06	Climate risk is a growing concern for investors, as it can have significant financial implications (Campiglio et al., 2018).
Carbon tax	0.05	Carbon taxes are a specific policy instrument that can influence investor behavior and attention (Murray & Rivers, 2015).
Carbon pricing	0.05	Carbon pricing mechanisms, such as emissions trading schemes, are another policy instrument that can impact investor attention (World Bank, 2020).
Carbon trading	0.04	Carbon trading is closely related to carbon pricing and is a key component of emissions trading schemes (Tietenberg, 2006).
Carbon footprint	0.04	Carbon footprint is a widely used metric that investors consider when assessing the environmental impact of their investments (Hoffmann & Busch, 2008).
Emission reduction targets	0.05	Emission reduction targets set by companies and governments can influence investor attention and decision-making (Ibikunle & Steffen, 2017).
Paris Agreement	0.05	The Paris Agreement is a landmark international climate treaty that has significant implications for investors (Savaresi, 2016).
Renewable energy	0.06	Renewable energy is a key focus area for climate-related investments and is expected to attract significant investor attention (Eyraud et al., 2013).
Clean energy	0.05	Clean energy is closely related to renewable energy and is another important focus area for climate-related investments (Eyraud et al., 2013).
Energy transition	0.04	The transition from fossil fuels to clean energy sources is a major theme that is likely to influence investor attention (Edenhofer et al., 2011).
Energy efficiency	0.03	Energy efficiency is an important aspect of climate change mitigation and can attract investor interest (Linares & Labandeira, 2010).
Electric vehicles	0.03	Electric vehicles are an emerging technology that is expected to play a significant role in reducing greenhouse gas emissions and may attract investor attention (Yong et al., 2015).
Sustainable infrastructure	0.03	Sustainable infrastructure projects, such as green buildings and public transportation, can attract climate-related investments (McKinsey, 2016).
Environmental regulations	0.04	Environmental regulations can have a significant impact on investor behavior and decision-making (Ambec et al., 2013).
ESG investing	0.03	Environmental, Social, and Governance (ESG) investing is a growing trend that incorporates climate-related factors into investment decisions (Friede et al., 2015).

Sustainable investing	0.03	Sustainable investing, which includes climate-related considerations, is becoming increasingly popular among investors (Global Sustainable Investment Alliance, 2018).
Green bonds	0.02	Green bonds are a specific financial instrument designed to fund environmentally friendly projects and can attract climate-focused investors (Climate Bonds Initiative, 2020).
Climate bonds	0.02	Climate bonds are similar to green bonds but specifically target projects aimed at addressing climate change (Climate Bonds Initiative, 2020).
Green finance	0.02	Green finance refers to the broader ecosystem of financial instruments and investments that support environmental objectives, including climate change mitigation and adaptation (G20 Green Finance Study Group, 2016).
Climate risk assessment	0.03	Climate risk assessment is a process that investors use to evaluate the potential impacts of climate change on their investments (Task Force on Climate-Related Financial Disclosures, 2017).
Climate resilience	0.02	Climate resilience refers to the ability of systems and organizations to adapt to and withstand the impacts of climate change, which is a growing concern for investors (United Nations Environment Programme Finance Initiative, 2019).
Green New Deal	0.02	The Green New Deal is a proposed set of policies aimed at addressing climate change and economic inequality, which has gained attention from investors and the general public (Rifkin, 2019).
Total	1.00	

Note: Keywords are justified by corresponding literature. Weight assignment is based on relative importance of those topic to the hypothesis.

Appendix D

Environmental Policy Stringency Index

Table D 1. Environmental Policy Stringency Index

Country / Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Australia	1,14	1,47	1,81	2,22	2,22	2,36	2,53	2,83	3,00	3,42	3,53	2,69	2,69	2,69	2,75	2,86	2,86	2,92
Austria	2,19	2,19	2,31	2,53	2,25	2,67	2,94	3,08	3,06	2,94	3,28	3,11	2,94	2,94	2,94	3,08	3,14	3,31
Belgium	1,56	2,47	2,58	2,64	2,31	2,64	2,67	2,56	2,94	3,06	2,94	2,94	2,83	2,89	2,94	3,00	3,22	3,44
Canada	1,89	1,89	2,06	2,47	2,86	2,94	3,19	3,61	3,61	3,44	3,44	3,19	2,53	2,36	2,58	2,69	2,64	3,03
Czechia	2,42	2,42	2,42	2,72	2,64	3,08	3,19	3,11	3,11	3,25	3,00	2,50	2,56	2,72	2,72	2,89	3,11	2,94
Denmark	2,64	2,81	3,03	3,14	3,14	3,19	3,42	4,08	4,22	3,89	4,06	4,11	4,03	3,94	4,03	3,78	3,67	3,72
Finland	2,42	2,64	2,75	2,97	2,97	3,19	3,17	3,11	3,75	3,64	3,64	3,69	3,86	3,83	3,83	3,92	3,81	4,11
France	2,08	2,83	2,86	3,08	3,25	3,42	3,69	3,61	3,94	3,92	3,92	4,22	4,03	3,92	4,17	4,56	4,72	4,89
Germany	2,67	2,78	2,89	2,94	2,78	3,03	3,14	3,08	3,17	3,06	3,22	3,11	3,03	3,08	3,03	3,25	3,31	3,47
Greece	1,47	1,42	1,78	1,89	1,97	2,25	2,44	2,61	2,75	2,64	2,58	2,89	3,06	2,89	2,86	2,86	2,83	2,89
Hungary	2,36	2,22	2,83	2,97	2,78	3,06	3,64	3,53	3,67	3,56	2,89	2,89	2,97	2,69	3,11	2,69	2,75	2,81
Ireland	1,97	2,03	2,08	2,44	2,36	2,64	2,67	2,67	2,58	2,58	2,81	2,86	2,86	2,50	2,44	2,50	2,56	3,00
Italy	1,92	1,97	2,22	3,14	2,97	3,08	3,28	3,47	3,50	3,58	3,67	4,00	4,06	4,06	4,06	3,78	3,75	3,72
Japan	2,75	3,03	3,03	2,97	3,06	3,00	3,11	3,22	3,42	4,06	3,83	3,83	3,72	3,94	3,89	3,61	3,78	3,78
Korea	1,81	2,22	3,14	3,31	3,31	3,14	3,31	3,39	3,61	3,00	3,00	2,83	2,94	3,00	3,00	3,11	3,17	3,17
Netherlands	1,78	1,81	2,75	2,78	2,78	3,22	3,56	3,75	3,17	3,14	3,06	3,11	3,19	3,33	3,11	3,50	3,47	3,47
Norway	2,25	2,25	2,47	2,47	2,81	2,97	3,67	3,67	3,72	3,67	3,67	3,72	3,72	3,72	3,72	3,83	3,89	3,94
Poland	1,28	1,33	2,08	2,36	2,25	2,58	2,78	2,94	3,00	2,72	2,89	2,94	2,94	2,83	2,89	3,06	3,42	3,47
Portugal	2,28	2,28	2,67	2,69	2,36	2,69	2,75	2,75	2,92	2,81	2,81	2,11	2,17	2,39	2,39	2,39	2,67	2,78
Slovak Republic	1,47	1,47	2,08	2,14	1,81	1,81	2,42	2,31	2,69	2,58	3,17	3,00	2,83	3,06	2,42	2,56	2,44	2,50
Slovenia	0,53	0,53	2,03	2,08	2,08	2,25	2,92	2,86	2,86	2,75	2,92	2,89	2,89	2,94	3,00	3,00	3,17	3,22
Spain	1,47	2,22	2,36	2,39	2,47	2,56	2,67	2,61	2,83	2,81	2,22	2,39	2,39	2,28	2,28	2,44	2,44	2,50
Sweden	3,08	3,14	3,08	3,25	3,08	3,42	3,61	3,61	3,50	3,39	3,44	3,56	3,61	3,67	3,61	3,67	3,61	3,83
Switzerland	2,25	2,25	2,28	2,28	2,53	3,17	3,36	3,33	3,56	3,64	3,64	4,06	4,03	4,14	4,14	4,42	4,22	4,50
Türkiye	0,83	0,83	0,78	1,61	1,61	1,64	1,69	2,56	2,78	2,39	2,53	2,53	2,61	2,69	2,78	2,72	2,89	2,89
United Kingdom	2,14	2,14	2,31	2,42	2,25	2,47	2,67	3,36	3,33	2,89	3,22	3,75	3,86	3,36	3,47	3,53	3,53	3,61
United States	1,22	1,22	1,22	1,67	1,67	1,89	2,33	2,03	2,03	2,36	2,44	2,42	2,47	2,97	2,97	2,92	2,92	3,03
Brazil	0,75	0,56	0,56	0,56	0,22	0,22	0,22	0,22	0,17	0,25	0,58	0,58	0,64	0,89	0,89	0,89	0,89	0,89
China (People's Republic of)	0,36	0,69	0,69	0,69	0,69	0,81	0,97	1,31	1,47	2,47	2,53	2,75	2,89	2,78	2,83	2,86	2,94	3,14
India	1,31	1,31	1,56	1,56	1,50	1,50	1,58	1,69	1,78	1,86	1,78	1,86	1,97	2,53	2,53	2,69	2,69	2,83
Indonesia	0,25	0,25	0,25	0,33	0,33	0,33	0,33	0,67	0,83	0,83	0,75	0,75	0,75	1,08	1,25	1,31	1,56	1,64
Russia	0,72	0,67	0,67	0,67	0,67	0,67	0,67	0,67	0,67	0,67	1,08	1,08	1,08	1,17	1,17	1,17	1,17	1,17
South Africa	0,25	0,25	0,19	0,44	0,44	0,39	1,11	1,83	1,53	0,86	0,86	0,86	0,86	0,86	0,86	0,92	0,86	0,92

Note: Top five countries within a given year are highlighted (grey)