International Political Uncertainty and Climate Risk Premium

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Abstract

This paper investigates how political uncertainty affects firms' climate risk premium from a global point of view. We use the presidential election events in the United States as well as that from all countries with a stock market as proxies for political uncertainty. We find that the global stock markets respond significantly to political uncertainty induced by the U.S. presidential elections, but not so for elections from their home countries. Although we do not observe a significant change in return premium for firms with different level of climate risk during the periods of political uncertainty, we find that firms with higher climate risk experience much higher return volatility and return correlation amid uncertainty associated with U.S. elections. The results are consistent with the literature that U.S. presidential election is a better indicator of international political uncertainty. At the same time, we uncover the new evidence on how political uncertainty affects the riskiness of firms with high exposure to climate risk.

JEL Classifications: G12, G15, and G32.

Key Words: International political uncertainty; Elections; Climate change exposure; Climate risk premium.

1. Introduction

This paper studies the effects of international political uncertainty on the climate change risk premium. Understanding the effects is important for understanding the stock market reactions and riskiness of firms with various climate change risk exposure in today's international financial markets. Political uncertainty has important asset pricing implications. Pástor and Veronesi (2013) develop a theorical model to show that political uncertainty is associated with a risk premium in the stock market, and it also causes higher volatility and more correlations among stocks. Studies in the literature have also provided empirical evidence about the effects of political uncertainty on financial markets[1]. Given the importance of political uncertainty, recent studies consider the economic and financial integration and spillover effects between countries[2] and further extend political uncertainty into an international domain. For example, Chau et al. (2014) study the political uncertainty induced by the civil uprisings of "Arab Spring" and find that the effects of political uncertainty on the stock market volatility differ across countries. By focusing on the stock market response to the US-Chinese trade war, Egger and Zhu (2020) show that the protectionist tariffs hurt market performance of not only firms in the acting country but also those in third countries that are not party to the trade war. Their results are consistent with that political uncertainty plays a crucial role in today's international financial market. Following Pástor and Veronesi (2013), Brogaard et al. (2020) use the 2016 and 2020 U.S. presidential general elections to measure international political uncertainty and find that

[1] See, for example, Baker, Bloom and Davis (2016), Fernández-Villaverde et al. (2015), Goodell and Vahamaa (2013), and Kelly, Pastor and Veronesi (2016).

[2] Political shock can spillover from one country to other countries and "raise global risk aversion, resulting in sharp corrections in financial markets" (International Monetary Fund 2013, p. 70)

political uncertainty, induced by the U.S. election cycle, not only has impacts in the U.S. stock market, but also has strong influence over the international markets.

However, among all the studies of international political uncertainty, none of them examine a particular type of risk premium that is associated with firm's climate change risk exposures. It's worth noting that climate change poses great challenge for firms across the whole world. Bansal et al. (2016) reveal that climate risk (e.g., global warming) produces the positive risk premium in stock markets. The climate risk includes the physical risk and transition risk (Dafermos et al., 2018; Monasterolo, 2020). In fact, the climate transition risk is closely related to the international political uncertainty. The political uncertainty often results in uncertain climate change policy. For example, U.S. withdraws from the Paris Agreement during the climate change skeptic Donald Trump era. However, U.S. rejoin the Paris Agreement after the election of Joe Biden. There are huge differences in climate change policies between the Trump era and Biden era. Uncertain climate change policy in U.S. may become an external important risk factor for stock markets, which affect U.S. stock market, as well as stock markets in other countries. Additionally, Shahnazari et al. (2014) argue that political uncertainty (or political cycles) has an important impact on global greenhouse gas mitigation policy, which affects the investment decisions of companies. Blyth et al. (2007) point out that climate change policy uncertainty is an external risk factor that the firm has no control, which may affect investment behaviour of private firms. Fuss et al. (2008) also believe that climate change is one of the most important systematic risks in today's world, and uncertain climate policy has an effect on the investment decision-making of firms (especially the carbon-intensive energy sector). Chen and Kettunen (2017) show that uncertain carbon policy affects the corporate expected

profit, consumer surplus, and corporate cost for accomplishing the carbon dioxide emission goal. The above-mentioned literature shows that climate change policy uncertainty affects the fundamentals (such as investment and expected profit) of the company. Thus, it may affect the stock performance of the company. Ilhan et al. (2021) point out that a theoretical framework provided by Pástor and Veronesi (2013) can used to explain why uncertain climate policy may affect asset prices. In Pástor and Veronesi (2013) model, policymakers decide whether to change its current policies. Potential new policies are heterogeneous in advance. Uncertain policies lead investors to demand compensation for political events. As a result, investors' expectations of future policy changes have an impact on asset prices. Furthermore, Jing and Zl (2020) use the real options theory to study whether uncertainty affects the companies' sustainability performance, and find both climate change uncertainty and political uncertainty (including economic policy uncertainty and political instability uncertainty) exercise negative influences on the companies' sustainability performance. Therefore, it is necessary to consider both political uncertainty and climate change risk when studying stock market.

In this study, we investigate the effects of international political uncertainty on risk premium associated with climate change risk exposures. We follow Brogaard et al. (2020) and use 3- and 6-month periods prior to U.S. presidential elections as proxies for international political uncertainty. Additionally, we also use the presidential elections at the global firms' home countries as the political uncertainty index. Our results are consistent with Brogaard et al. (2020) and showing that U.S. presidential elections are a better indicator of global political uncertainty.

Studying firms from 34 countries, we find inconclusive conclusion on the relationship

between political uncertainty and climate risk premium. We find that firms with higher climate risk as proxied by climate risk exposure measure from Sautner et al. (2021) perform worse in the three-month periods prior to the U.S. presidential election, but not when we change the political uncertainty indicator to be 6 months' time window prior to the election. In addition, we find that the negative correlation only exists for the time periods in the 2000s, but not during 2010s. Although the risk premiums from the group of firms with varying climate risk exposures are not affect by the political uncertainty consistently, we find more robust results on how political uncertainty can affect high climate risk firm's riskiness.

Using both 3- and 6-months' time window prior to U.S. presidential elections, we find a strong correlation between climate risk and firm's return volatility during the periods of uncertainty. During the periods of uncertainty, firms with higher climate risk exposure are more likely to have higher return volatility. Besides return volatility, we also find evidence that firms with higher climate risk exhibit higher return correlation among them during the uncertainty periods. We compare the return correlation of firms in the groups of top or bottom quintile of climate risk within each country, and find that stock returns of the firms under top climate risk tend to correlate more during the uncertainty periods. Thus, both results show that higher climate risk firms possess a greater risk for the investors during the periods of political uncertainty. Though, it is worth noting that our results become insignificant when we replace the political uncertainty using the presidential elections from firms' home countries, instead of U.S. elections.

This study contributes to the literature of political uncertainty. Our results add to the international political uncertainty literature as this study provides new international

evidence on the relation between political uncertainty and risk premium proposed by Pástor and Veronesi (2012, 2013). While Ramelli et al. (2018) study the impacts of Trump's 2016 election on the market reaction to carbon-intensive firms, we investigate the effects of political uncertainty on firms' climate risk premium across different countries.

This study also contributes to climate risk literature. It deepens the understanding of the importance of climate risk discussed by Krueger et al. (2020). We provide evidence on the importance of climate risk for firms in an international environment and this evidence is consistent with prior studies. Additionally, our results extend the existing political uncertainty and climate risk literature such as Ilhan et al. (2021) into an international domain. We test the asset pricing implication of climate risk association conditional on firms' home country[3] national elections and find that the significant correlation is close to nonexistence when compared with the political uncertainty induced by U.S. presidential elections. It implies that U.S. presential election is a better measure of political uncertainty than home country elections for international financial markets. These results are in support of Brogaard et al. (2020)'s argument that US presidential election has great implications for global stock returns.

This study is structured as follows. Section 2 reviews related literature. Section 3 presents the data and summary statistics. Section 4 provides model and empirical results. The empirical results include the effects of the interaction of political uncertainty and climate risk on stock returns, return volatilities, and return correlations from a global perspective. Section 5 concludes.

[3] We identify the home country of a firm based on where its headquarter is located at.

2. Literature Review

Both political uncertainty and climate change risk have become important topics for Finance researchers in these years. Previous studies in the literature investigate the importance of political uncertainty for financial markets. Pástor and Veronesi (2012) develop a theorical model to study the effect of political uncertainty on stock prices. They find that the stock price largely declines when political uncertainty is high and the change about government policy is preceded by a short or small economic downturn. Additionally, political uncertainty has positive impacts on volatilities and correlations among stocks. Pástor and Veronesi (2013) propose a general equilibrium model in which stock prices respond to political change. Their empirical results show that political uncertainty is closely related with a risk premium in the stock market, which also leads to bigger volatility and more correlations among different stocks.

More empirical evidence emerges following Pástor and Veronesi (2012, 2013). Goodell and Vähämaa (2013) point out that U.S. presidential elections cause uncertainty, which affects the implied volatility in the U.S. stock market. Chau et al. (2014) investigate the effect of political uncertainty on the volatility of major stock markets in the Middle East and North African countries. The results show that the effects of political uncertainty on the volatility in different stock markets are different. Colak et al. (2017) indicate that political uncertainty surrounding U.S. gubernatorial elections causes a dampening effect on IPO activity. The dampening effect is associated with lower IPO offer prices in election years.

Alternatively, Liu et al. (2020) measure political uncertainty based on the turnovers of city government leaders. They study the effect of political uncertainty on the cross-

section of expected stock returns in China, which finds that the firms in the cities with higher political uncertainty have higher returns. In addition to the above studies, many studies also demonstrate that political uncertainty has an important effect on the prices, returns and volatilities of some financial assets (e.g., Bittlingmayer, 1998; Brogaard and Detzel, 2015; Chan et al., 2020; Kelly et al., 2016; Liu et al., 2017; Pantzalis et al., 2000; Smales, 2014; Tirtiroglu et al., 2004).

The most recent examples of great political uncertainty events are the 2016 and 2020 U.S. presidential general elections. Brogaard et al. (2020) find that political uncertainty induced by the U.S. election cycle not only has impacts in the U.S. stock market, but also has strong influence over the international markets. The International Monetary Fund (2013)'s report shows that political shock can spillover from one country to other countries and "raise global risk aversion, resulting in sharp corrections in financial markets" (International Monetary Fund 2013, p. 70). Therefore, we propose a study on how the election induced political uncertainty is associated with risk premium from a global perspective.

Instead of examining the overall stock market risk premium, this study focuses on a particular type of risk premium that is associated with firm's climate change risk exposures. As investors realize the importance of climate change in recent years, it poses great challenge for investors, firms, financial markets, and policy makers across the whole world. The climate-related financial risks can be classified into the physical risk and transition risk. The physical risk is related to the economic and financial losses of climate-induced weather events; and the transition risk refer to the economic and financial damages arising from the re-valuation of carbon-intensive assets as a result of shocks related to the

transition to a low-carbon economy (Dafermos et al., 2018; Monasterolo, 2020). So far, many studies have focused on the effects of physical risk (e.g., Bovari et al., 2018; Burke et al., 2015, 2018; Campiglio et al., 2018; Coronese et al., 2019; Diffenbaugh and Burke, 2019; Dietz et al., 2016; Painter, 2020) and transition risk (e.g., Benedetti et al., 2021; Battiston et al., 2017; Carbon Tracker Initiative, 2011; Sen and Schickfus, 2020; Stolbova et al., 2018) on economy and finance. Investors believe that regulatory risk (or transition risk) that stems from the policy changes is a very important source of climate risk (Stroebel and Wurgler, 2021) and is regarded as having even more impacts than the physical climate risks (Krueger et al. 2020).

For stock markets, Bansal and Ochoa (2011) examine the relationship between temperature and stock returns in different countries around the world. They prove the existence of a temperature risk premium, and find that global warming has a greater impact on countries near the equator. Bansal et al. (2016) further find global warming brings the positive risk premium in the U.S. and global stock markets. This risk premium increases with the level of temperature, and has nearly doubled in the past 80 years with rising temperatures, reflecting the high economic costs of climate change. They also point out that all U.S. stock portfolios exist negative exposure (beta) to long-run temperature changes. Pham et al. (2019) study the impacts of the Paris Climate Agreement on the 17 industries of German stock market. They find that the announcements about the Paris Climate Agreement have important effects on the return and risk of polluting industries. From the perspective of transition risk, the higher the level of corporate carbon emissions, the greater the impact it will be affected by climate policies. For example, the higher the transition risk of carbon-intensive companies, because policies to mitigate climate problems often adopt

carbon taxes and carbon emission rights. Measures such as transactions and pollution restrictions will have a negative impact on the future cash flow of carbon-intensive companies, coupled with the impact of new energy technologies, resulting in a negative correlation between carbon emissions and corporate value (Hsu et al., 2021). Rubtsov et al. (2021) prove that although the financial risks brought by climate change to the stock market can be effectively hedged by constructing corresponding investment portfolios, the loss of stock investor welfare caused by climate uncertainty such as global warming will not significantly reduce. Roncoroni et. al (2021) demonstrate the impact on financial stability of the interaction between climate policy shocks and market conditions. In addition, the additional risks brought about by the increase in drought (Hong et al., 2019; Huynh et al., 2020), hurricanes (Alok et al., 2020; Dessaint and Matray, 2017; Kruttli et al., 2019), and tornadoes (Alok et al., 2020) under global warming are also reflected in stock asset pricing.

Our study is related to the study by Alessi, Ossola and Panzica (2021). They show empirical evidence about the existent of a negative risk premium (called greenium) in European countries. It implies that investors accept negative return for investing in companies with high level of greenness in greenhouse gas emissions and transparency of environmental disclosures. Our study is different from their work in that: (1) we consider the political uncertainty as an external impacting factor that is omitted by their study; (2) we focus on the risk premium associated with climate change exposure that include more information than greenhouse gas emissions; and (3) we study the international stock markets in addition to European markets.

In sum, both political uncertainty and climate risk are important considerations for investors, researchers and policy makers. We link these two together in this study and

extend our examination into an international study, and provide evidence showing that stock market for firms with higher climate risk might be more destabilized during political uncertainty periods.

3. Data and Summary Statistics

In this section, we discuss the data and summary statistics of important variables in this study. We follow Brogaard et al. (2020) and define the periods of political uncertainty as three or six months prior to an election. Global election data is collected from the Internet resource Election Guide[4]. It is cross-checked with other resources such as the World Bank Political Institution database and Wikipedia. We use the global election cycles to infer the periods of the political uncertainty that stems from the elections from firms' home countries. Given such periods, we construct two indicator variables of political uncertainty for the three and six months prior to an election date and assign a value of one if a month falls within the time window and zero otherwise. Two sets of political uncertainty indicator variables are used: one is the time periods precedes the U.S. presidential elections and the other is the time periods precedes the national elections in the firm's home country.

Our data of climate risk comes from Sautner et al. (2021)[5] who use machine learning technique to identify the firm level climate change exposure by examining the key words that are related to climate change risks in the earning conference calls. This measure of exposure to climate change, as stated by Sautner et al. (2021), is constructed "using the

[4]Link to the resource is: http://www.electionguide.org.
[5]Link to the data is: https://doi.org/10.17605/OSF.IO/FD6JQ. We thank the authors to make the data available.

entire conference call, including both the management presentation and the question-and-answer session with analysts". Specifically, this measure counts the frequency of climate change bigrams in a transcript and then scales it by total number of bigrams in the transcript. It can be interpreted as the climate risk exposure perceived by market participants. This measure of firm climate risk has several advantages. First, it is a firm level measure that allows researchers to conduct deeper analysis by connecting it with firm characteristic and returns on top of market level analysis. Second, this measure from machine learning is more objective and less biased than survey data when processing similar information from earning conference calls. Third, this data covers a wide range of firms around the world for a reasonably adequate time window. This data contains 10,158 firms from 34 countries between 2002 and 2019.

Stock return and firm characteristics data is collected from Center for Research in Security Prices (CRSP) and Compustat databases. We use the Gvkey variable to merge different data source and the headquarter country information is cross checked in all these databases. A stock must have available climate risk data, stock price data, and accounting information data to be included in this study. As a result, we end up with 721,775 firm-month observations for monthly stock returns for the period between 2002 and 2019.

The summary statistics for the variables used in this study are presented in Table 1. All observations are at the firm-month level. It is noticeable that the average monthly return is 0.7 percent, indicating an 8.7 percent average annual return for all the international firms studied. The average climate risk is 0.1 percent per month between 2002 and 2019, which is generally consistent with the results in Sautner et al. (2021).

[Insert Table 1 Here]

Next, we show the correlation between those firm level variables. Table 2 presents the correlation matrix for the variables reported in Table 1. It is not surprising that the stock return is significantly correlated with alpha, size, book-to-market ratio, and volatility at one percent level. The correlation ranges from 85% between alpha and return, to 3% between volatility and return. Besides, we can also find that the climate risk and stock return are significantly negatively correlated with each other at five percent level. This result confirms the importance of climate risk as discussed in Sautner et al. (2021). Although the magnitude is small, we also find that climate risk is significantly negatively correlated with book-to-market ratio and return volatility. Besides, there is a positive correlation between climate risk and firm size. As most of the variables are correlated with each other, we consider control for those variables in the regression analysis.

[Insert Table 2 Here]

4. Empirical Results

4.1 Stock Returns

While climate risk is negatively related with stock return, it is still not clear as to how political uncertainty interacts with climate risk in affecting stock returns. In this section, we consider the political uncertainty induced by the U.S. presidential elections as an external factor and then explore this question by regressing monthly stock returns on the interaction of climate risk and US presidential election time window indicator variable..

Control variables, country fixed effect and time fixed effect are also considered as described in Equation (1) below.

$$Return_{it} = \alpha_i + \beta_1\left(PU_{i,t} \times Climate\ Risk_{i,t-1}\right) + \beta_2 Climate\ Risk_{\ i,t-1} + \beta_3 PU_{i,t} + Controls_{i,t-1} + \delta_t + \varepsilon_{i,t} \quad (1)$$

where $PU_{i,t}$ is the U.S. presidential election time window indicator variable and $Climate\ Risk_{i,t-1}$ is the measure of climate risk. $PU_{i,t}$ is equal to one if a month falls in the time window (3 months for PU1 or 6 months for PU2) prior to the U.S. presidential elections and zero otherwise. The coefficient on the interaction term (β_1) indicates the relation between climate risk and international stock returns when facing the upcoming U.S. presidential election. Control variables include book-to-market ratio, size and stock return of last month. The country fixed effect and time fixed effect are included throughout. The individual term, *PU*, drops out of the equation after we included the time fixed effect, due to the perfect collinearity between them. The standard errors are clustered at the country and time level.

Panel A of Table 3 shows the results of regressions based on Equation (1). The results show that political uncertainty associated with the US presidential elections seems to have negative effect on the relation between climate risk and stock return. While stock return is negatively associated (coefficient of -0.17, not significant though) with climate risk in six months prior to the U.S. presidential election, this correlation becomes significant (coefficient of -0.82, significant at five percent level) in three months prior. This result shows that investors do not have strong preference in firms with high or low climate risks six months prior to the election days but they change their preference and firms with high climate risk experience significant lower returns when it is three months prior. In

regressions (3) and (4), we adjust monthly stock returns with the Fama and French (2015) five factor model. The adjusted return, alpha, shows a similar relation with climate risk considering political uncertainty. It is negative but insignificant when six months prior to presidential election and later becomes significant in three months prior. At the first glance, the mixed results seem inconclusive thus a further test is needed to see why it happens. It is possible that investors revise their expectation on stock market as the presidential election progresses. More and more investors realize the importance of climate risk. The dynamic potential outcome of election will lead to varying expectation on future government policy about climate change and expected return on firms with varying climate risks.

Studies in the literature such as Heflin and Wallace (2017) and Dyck et al (2019) use 2011 BP oil spill as an external shock to investors' view on the firms' environmental risk. On one hand, these studies suggest that firms tend to have more environmental disclosure, indicating that firms pay more attention to climate change risk. On the other hand, the results of these studies shows that investors become more concerned with climate change risk and environmental disclosure by firms will be better perceived by investors. Overall, results of these studies implies that investors have realized the importance of climate change risk and 2011 BP oil spill is a turning point in this trend. Motivated by these studies, we divide our whole sample period into before and after 2011. Panel B of Table 3 shows the results of subperiod analysis. The subperiod analysis results demonstrate that before 2011 firms with high climate risk tend to have low return within three months prior to the U.S. presidential election. The coefficient is -2.35, significant at one percent level. However, this is not the case when we use six-month windows before 2011, or using either

time windows after 2011[6]. We do not observe a significant climate risk premium and the relation between climate risk and stock return is not significantly different from zero when six months prior to election. From regression (5) to (8), we use the Fama and French (2015) five factor model alpha and the results are consistent with prior results. This evidence generally suggests that the relationship between political uncertainty and climate risk premium is far from reaching a conclusion. Moreover, there is a marginal negative climate risk premium when political uncertainty induced by the U.S. presidential election is high before 2011. After 2011, this climate risk premium does not exist with high political uncertainty as the relation becomes insignificant. Therefore, we believe that our tests on how political uncertainty affect the stock return premium associated with climate risk is inconclusive, especially given the later periods' results. We further investigate other impacts that political uncertainty might have the firms with high climate risk, namely, riskiness of those firms.

[Insert Table 3 Here]

4.2 Return Volatility

In this section, we examine how the stock return volatility is associate with the interaction of political uncertainty induced by US presidential elections and climate risk. As Pástor and Veronesi (2013) shows that political uncertainty causes higher volatility of stock returns, it is interesting to study this effect for firms with various levels of climate risk. We use a similar regression analysis as in Equation (2) below.

[6] In an un-tabulated result, we find that the results remain significant when we include 2012 election in the model before 2011, and results remain insignificant when we only include 2016 and 2020 elections.

$$Vol_{it} = \alpha_i + \beta_1\left(PU_{i,t} \times Climate\ Risk_{i,t-1}\right) + \beta_2 Climate\ Risk_{i,t-1} + \beta_3 PU_{i,t} + Controls_{i,t-1} + \delta_t + \varepsilon_{i,t} \quad (2)$$

where Vol_{it} is the monthly return volatility calculated from daily returns. The same control variables, country fixed effect and time fixed effect as in the last section are considered in the analysis.

Panel A of Table 4 shows that the positive coefficient of interaction term is statistically significant when it is six months or three months prior to US presidential elections. It implies that stocks with high climate risk become more volatile when facing the political uncertainty from the U.S. presidential elections. Panel B of Table 4 provides evidence that such effect is fairly prominent before 2011 and becomes significant only three months prior to US presidential elections after 2011. But in general this positive relation between climate risk and return volatility exists conditional on political uncertainty. It indicates that political uncertainty increases return volatility for firms with high climate risk. On the other hand, it also means that stock return volatility increases with the level of climate risk during the periods when political uncertainty is high. The result is consistent with the theoretical work by Pástor and Veronesi (2013), but with applications for firms with different climate risk. Additionally, their paper discovers the negative impact of political uncertainty beyond return volatility. That is the political uncertainty could induce the increase of the return correlation among the market. We next examine exact that.

[Insert Table 4 Here]

4.3 Return Correlations

Does political uncertainty affect correlations among stocks given a level of firm climate risk? To answer this question, we investigate how stock return correlation is associate with the interaction of climate risk and political uncertainty induced by US presidential elections. First, we sort stocks in each country into quintile groups based on firm level climate risk. The monthly stock return correlation is calculated as equal-weighted averages of pairwise correlation from daily returns between the top and bottom quintile groups of climate risk. Equation (3) below shows the regressions used in this section that control for country fixed effect.

$$Correlation_{it} = \alpha_i + \beta_1\left(PU_{i,t} \times High\_Climate\ Risk_{i,t-1}\right) + \beta_2 PU_{i,t} + \quad High\_Climate\ Risk_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

where $High\_Climate\ Risk_{i,t-1}$ represents climate risk of firms in the top quintile group in the country.

Panel A of Table 5 presents evidence that stock return correlation tends to be high for firms with high climate risk during period of political uncertainty. This positive association is significant six months or three months prior to the U.S. presidential elections. The coefficients of the interaction term, 0.017 and 0.020, are significant at ten percent and five percent level respectively. Panel B further shows that the effect is driven by post-2011 subperiod. Before 2011, there is no association between political uncertainty and stock return correlation for firms with high climate change exposure. However, the effect are much stronger and significant during the more recent periods, indicating that there are much stronger co-movement in returns among firms with very high or very low climate

risk when there is high political uncertainty after 2011. In sum, we find evidence that is consistent with Pástor and Veronesi (2013) and the subperiod analysis is also consistent with the implication of Heflin and Wallace (2017) and Dyck et al. (2019) in 2011 BP oil spill.

[Insert Table 5 Here]

4.4 Home Country Elections

Until now we have demonstrated the effect of political uncertainty induced by the U.S. presidential elections. How about the effect of political uncertainty induced by home country's presidential elections? In this section, we explore this question by replacing the U.S. presidential elections with each firm's home country election date and the results are presented in Table 6. We re-run the tests as described in Equations (1) to (3) but assign the indicator variables $PU_{i,t}$ value of one if a month falls in the time window prior to the specified firm's home country's presidential elections and value of zero otherwise.

Panel A shows the results on monthly stock returns as described in Equation (1). We find that there is a negative relation between climate risk and monthly stock returns. With 1 percent increase in a firm's climate risk, investors accept an average of 0.55 percent decrease of stock returns when three months proceeding to home country elections. This relation is significant at five percent level, indicating a negative climate risk premium subject to the political uncertainty induced by home country elections. However, there is no relation between climate risk and stock returns when six months prior to home country elections. When using Fama and French (2015) five factor model alpha, such relation

disappears for both six months and three months prior to the home country presidential election. Overall, the results suggest that political uncertainty is not significantly correlated with stock return for firms with high climate risk. It is possible that the home country election cycle does not capture the international political uncertainty that affects the global financial market. Comparing with the results in Table 4, it implies that investors are more concerned with the U.S. presidential election and thus the U.S. presidential election cycle better measures international political uncertainty. This is even more true for the other two results regarding return volatility and return correlations.

Panel B and Panel C show the results on monthly stock return volatility and return correlations respectively. All the coefficients of interaction terms are insignificant, meaning the association between political uncertainty and return volatility (and correlation) is minimum. Overall, results in Panel B to Panel C show almost none effect of political uncertainty induced by home country national elections on firms with various levels of climate risk. Most of the coefficients of interaction terms are not significant at all. Given the firm's climate risk, it indicates that home country national elections have less effect than the U.S. presidential elections on the international firms.

As a comparison with results of previous sections, our results imply that the U.S. presidential election is more influential on climate change risk premium of global firms than home country national elections. In other words, investors care more about the U.S. presidential election than about the firm's home country elections. Moreover, it supports that the U.S. presidential election is a good measure of global political uncertainty. These results are consistent with Brogaard et al. (2020)'s argument that the U.S. presidential election has great implications for global stock returns.

[Insert Table 6 Here]

5. Conclusions

Political uncertainty becomes an important consideration for investors and firms around the world. Since Pástor and Veronesi (2012, 2013), more and more empirical evidence is presented by studies with a focus on overall stock market risk premium. In this study, we focus on the effects of political uncertainty on a particular type of risk premium that is associated with firm's climate change risk exposure as investors have realized the importance of climate risk on financial markets and none of studies has addressed this crucial issue in literature. We extend this study into an international space because most of the studies in literature focuses on markets in only one country. This extension helps investors understand the globalization and spillover of financial markets from a political perspective. Moreover, two measures of political uncertainty are used: one is the time periods precedes the U.S. presidential elections and the other is the time periods precedes the national elections in the firm's home country. A comparison between these two measures helps investors deepen understanding about political uncertainty and its asset pricing implications.

To conclude, this study finds mixed evidence that international political uncertainty induced by the U.S. presidential elections has effects on climate change risk premium of international firms. However, we find strong evidence that firms with high climate risk tend to have higher return volatility and higher return correlations, implying a greater risk for investors holding high climate risk firms during the periods of political uncertainty.

There is no such interaction and association for international firms when facing the national election in their home countries though.

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Table 1. Summary Statistics

This table shows the summary statistics for the variables at firm-year level for firms from 34 countries. Return is the monthly stock returns. Alpha is stocks' monthly return adjusted by Fama and French (2015) five factor models. Size is the market capitalization calculated as the product of number of shares outstanding and stock price at the end of the month. B/M is the book-to-market ratio. Vol is the monthly return volatility calculated as the standard deviation of daily returns in the month. Climate Risk is the climate change risk exposure index for global firms provided by Sautner et al. (2021). The time periods are from 2002 to 2019. The total number of observations is 721,775.

	Mean	Std. Dev	P1	P25	P50	P75	P99
Return	0.007	0.132	-0.343	-0.054	0.005	0.063	0.399
Alpha	0.000	0.112	-0.280	-0.053	-0.003	0.047	0.330
Size	7.904	2.416	2.975	6.300	7.706	9.253	14.876
B/M	2.930	5.475	0.082	0.643	1.238	2.489	36.317
Vol	0.024	0.019	0.006	0.014	0.020	0.029	0.091
Climate Risk	0.001	0.003	0.000	0.000	0.000	0.001	0.013

Table 2. Correlations

This table shows the correlation matrix for the variables in Table 1. P-values are reported in the matrix. Asterisks *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Return	Alpha	Size	B/M	Vol	Climate Risk
Return	1					
Alpha	0.8535***	1				
	0.000					
Size	0.0380***	0.0184***	1			
	0.000	0.000				
B/M	-0.0548***	-0.0304***	0.0063***	1		
	0.000	0.000	0.000			
Vol	0.0375***	0.1158***	-0.3565***	0.1066***	1	
	0.000	0.000	0.000	0.000		
Climate Risk	-0.0025**	-0.0013	0.0409***	-0.0243***	-0.0156***	1
	0.0305	0.2708	0.000	0.000	0.000	

Table 3. U.S. Presidential Election and Stock Returns

This table presents the regression results of stock returns or Alpha on the interaction between political uncertainty (PU) indicator and climate risk index. Two political uncertainty indicators are used. PU1 is a time dummy that takes one if it is within six months prior to a U.S. presential elections and zero otherwise. PU2 takes one if it is within three months' time window. Climate risk and all control variables are defined the same as in Table 1. Lagged Return is stock's monthly return at a month earlier. Country and time fixed effects are included throughout the models. Standard errors are clustered at the countries and months. Statistical t-values are reported in the brackets. Asterisks *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A

	1	2	3	4
Dep. Var.	Stock Return		Alpha	
Indep. Var.	PU1	PU2	PU1	PU2
Political Uncertainty (PU) * Climate Risk	-0.1660	-0.8188**	-0.0390	-0.7535**
	[-0.435]	[-2.303]	[-0.117]	[-2.257]
Climate Risk	-0.3041***	-0.2727**	-0.1545**	-0.1109
	[-2.869]	[-2.594]	[-2.258]	[-1.475]
BM	-0.0012***	-0.0013***	-0.0007***	-0.0007***
	[-4.718]	[-4.717]	[-4.590]	[-4.589]
Size	0.0033***	0.0033***	0.0018***	0.0018***
	[8.699]	[8.701]	[7.779]	[7.782]
Lagged Return	-0.0201***	-0.0201***	-0.0373***	-0.0373***
	[-3.661]	[-3.668]	[-11.072]	[-11.081]
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	719,437	719,437	719,437	719,437
R-squared	0.167	0.167	0.018	0.018

Panel B

	1	2	3	4	5	6	7	8
Dep. Var.	Stock Return				Alpha			
Year	2002-2010		2011-2020		2002-2010		2011-2020	
Indep. Var.	PU1	PU2	PU1	PU2	PU1	PU2	PU1	PU2
Political Uncertainty (PU) * Climate Risk	0.5056	-2.3534***	-0.3710	-0.3716	0.3214	-2.8629***	-0.1513	-0.1385
	[0.502]	[-3.811]	[-1.344]	[-0.958]	[0.270]	[-8.034]	[-0.587]	[-0.414]
Climate Risk	-0.3384	-0.1450	-0.3039***	-0.3285***	-0.1789*	0.0227	-0.1443*	-0.1553*
	[-0.364]	[-0.648]	[-2.786]	[-3.137]	[-1.701]	[0.157]	[-1.725]	[-1.904]
BM	-0.0017	-0.0017***	-0.0010***	-0.0010***	-0.0009	-0.0009	-0.0006***	-0.0006***
	[-0.496]	[-3.616]	[-5.543]	[-5.542]	[-0.066]	[-0.458]	[-4.554]	[-4.553]
Size	0.0035	0.0035***	0.0034***	0.0034***	0.0025	0.0025	0.0016***	0.0016***
	[0.645]	[4.709]	[10.550]	[10.546]	[0.123]	[1.144]	[6.874]	[6.872]
Lagged Return	-0.0215	-0.0216**	-0.0201***	-0.0201***	-0.0445	-0.0446***	-0.0323***	-0.0323***
	[-0.687]	[-2.222]	[-2.914]	[-2.914]	[-1.153]	[-4.964]	[-6.925]	[-6.925]
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	221,359	221,359	498,078	498,078	221,359	221,359	498,078	498,078
R-squared	0.206	0.206	0.134	0.134	0.022	0.022	0.015	0.015

Table 4. U.S. Presidential Election and Return Volatility

This table presents the regression results of stock return volatility on the interaction between political uncertainty (PU) indicator and climate risk index. Two political uncertainty indicators are used. PU1 is a time dummy that takes one if it is within six months prior to a U.S. presential elections and zero otherwise. PU2 takes one if it is within three months' time window. Climate risk and all control variables are defined the same as in Table 1. Lagged Return is stock's monthly return at a month earlier. Country and time fixed effects are included throughout the models. Standard errors are clustered at the countries and months. Statistical t-values are reported in the brackets. Asterisks *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A

	1	2
Dep. Var.	Return Volatility	
Indep. Var.	PU1	PU2
Political Uncertainty (PU) * Climate Risk	0.0450***	0.0679***
	[2.814]	[2.968]
Climate Risk	-0.0202	-0.0187
	[-0.578]	[-0.534]
BM	0.0003***	0.0003***
	[3.266]	[3.266]
Size	-0.0029***	-0.0029***
	[-6.005]	[-6.005]
Lagged Return	-0.0053***	-0.0053***
	[-3.585]	[-3.584]
Country FE	Yes	Yes
Time FE	Yes	Yes
Observations	719,273	719,273
R-squared	0.372	0.372

Panel B

	1	2	4	5
Dep. Var.	Return Volatility			
Year	2002-2010		2011-2020	
Indep. Var.	PU1	PU2	PU1	PU2
Political Uncertainty (PU) * Climate Risk	0.1113**	0.1258***	0.0322	0.0596**
	[2.196]	[2.759]	[1.393]	[2.067]
Climate Risk	-0.0208	-0.0154	-0.0169	-0.0165
	[-0.496]	[-0.340]	[-0.535]	[-0.531]
BM	0.0006***	0.0006***	0.0001***	0.0001***
	[3.238]	[3.237]	[2.843]	[2.843]
Size	-0.0034***	-0.0034***	-0.0027***	-0.0027***
	[-5.425]	[-5.423]	[-6.604]	[-6.604]
Lagged Return	-0.0050*	-0.0050*	-0.0053***	-0.0053***
	[-1.882]	[-1.879]	[-4.363]	[-4.362]
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	221,200	221,200	498,073	498,073
R-squared	0.437	0.437	0.250	0.250

Table 5. U.S. Presidential Election and Return Correlation

This table presents the regression results of stock return correlation on the interaction between political uncertainty (PU) indicator and high climate risk indicator. Stock return correlation measures the return correlation among stocks with different levels of climate risks in each country. We use the correlation data among the groups that are within the top and bottom quintiles of climate risk within each country. The High Climate Risk indicator takes the value of one when it is in the top quintile and zero when it is in the bottom quintile. Two political uncertainty indicators are used. PU1 is a time dummy that takes one if it is within six months prior to a U.S. presential elections and zero otherwise. PU2 takes one if it is within three months' time window. Country fixed effects are included throughout the models. Standard errors are clustered at the countries. Statistical t-values are reported in the brackets. Asterisks *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A

	1	2
Dep. Var.	Return Correlation	
Indep. Var.	PU1	PU2
Political Uncertainty (PU) * High Climate Risk	0.0172*	0.0204**
	[1.908]	[2.125]
High Climate Risk	0.0554***	0.0564***
	[4.976]	[5.028]
Political Uncertainty (PU)	0.0028	-0.0079
	[0.440]	[-1.093]
Country FE	Yes	Yes
Observations	15,945	15,945
R-squared	0.136	0.136

Panel B

	1	2	4	5
Dep. Var.	Return Correlation			
Years	2002-2010		2011-2020	
Indep. Var.	PU1	PU2	PU1	PU2
Political Uncertainty (PU) * High Climate Risk	-0.0130	0.0142	0.0249**	0.0235**
	[-0.757]	[0.773]	[2.614]	[2.113]
High Climate Risk	0.0661***	0.0638***	0.0530***	0.0552***
	[4.588]	[4.459]	[4.709]	[4.822]
Political Uncertainty (PU)	-0.0006	0.0319**	0.0092	-0.0224**
	[-0.057]	[2.624]	[0.987]	[-2.196]
Country FE	Yes	Yes	Yes	Yes
Observations	5,697	5,697	10,248	10,248
R-squared	0.146	0.148	0.178	0.176

Table 6. Political Uncertainty using Home Country Presidential Elections

This table presents the results that are similar in Tables 3 to 5, except for the political uncertainty measure. We replace the political uncertainty variable using the presidential elections from each stock's home country. All other variables are defined the same as in Tables 3 to 5. Asterisks *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A

	1	2	3	4
Dep. Var.	Stock Return		Alpha	
Indep. Var.	PU1	PU2	PU1	PU2
Political Uncertainty (PU) * Climate Risk	-0.0458	-0.5528**	0.1034	-0.4129
	[-0.239]	[-2.032]	[0.618]	[-1.519]
Political Uncertainty (PU)	0.0014	0.0002	0.0005	0.0001
	[0.691]	[0.086]	[0.358]	[0.076]
Climate Risk	-0.3132***	-0.2848***	-0.1669**	-0.1296*
	[-3.071]	[-2.860]	[-2.541]	[-1.716]
BM	-0.0012***	-0.0012***	-0.0007***	-0.0007***
	[-4.697]	[-4.695]	[-4.553]	[-4.550]
Size	0.0033***	0.0033***	0.0018***	0.0018***
	[8.560]	[8.560]	[7.661]	[7.658]
Lagged Return	-0.0198***	-0.0198***	-0.0375***	-0.0375***
	[-3.606]	[-3.608]	[-11.175]	[-11.180]
Country FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	719,437	719,437	719,437	719,437
R-squared	0.167	0.167	0.018	0.018

Panel B

	1	2
Dep. Var.	Return Volatility	
Indep. Var.	PU1	PU2
Political Uncertainty (PU) * Climate Risk	-0.0115	0.0124
	[-0.421]	[0.322]
Political Uncertainty (PU)	0.0000	0.0005
	[0.126]	[0.999]
Climate Risk	-0.0122	-0.0143
	[-0.327]	[-0.392]
BM	0.0003***	0.0003***
	[3.260]	[3.259]
Size	-0.0029***	-0.0029***
	[-5.988]	[-5.986]
Lagged Return	-0.0053***	-0.0053***
	[-3.531]	[-3.531]
Country FE	Yes	Yes
Time FE	Yes	Yes
Observations	721,611	721,611
R-squared	0.372	0.372

Panel C

	1	2
Dep. Var.	Return Correlation	
Indep. Var.	PU1	PU2
Political Uncertainty (PU) * High Climate Risk	0.0068	-0.0001
	[0.795]	[-0.016]
Political Uncertainty (PU)	-0.0051	-0.0035
	[-0.606]	[-0.389]
High Climate Risk	0.0571***	0.0579***
	[5.064]	[5.167]
Country FE	Yes	Yes
Observations	15,945	15,945
R-squared	0.136	0.136