Gubernatorial Elections and Option Pricing

Methods Section

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June 16, 2023

Abstract

This paper addresses gaps in the literature by investigating the impact of political uncertainty during gubernatorial elections on implied stock volatility. Drawing on theoretical models and prior research, we hypothesize that firms registered in states with gubernatorial elections will experience greater political uncertainty and an increase in implied volatility compared to firms in states without such elections. We introduce a more nuanced approach to measuring electoral uncertainty using poll data and examine the 2021 US gubernatorial elections in Virginia and New Jersey as our case study. Our sample includes utility companies from the SP 500 index, focusing on their implied volatility during the election period. We employ regression discontinuity and two-way fixed effects difference-in-difference models to estimate the causal effects. The results indicate that firms registered in states with gubernatorial elections experience higher political uncertainty and increased implied volatility leading up to the election. Moreover, companies in states with higher electoral uncertainty exhibit greater political uncertainty and a larger increase in implied volatility. These findings provide empirical evidence supporting our hypotheses. However, due to the limited sample size and timeframe, further research with a larger dataset and an extended post-election period is warranted to establish more robust conclusions.

1 Backgrond and Motivation

An emerging stream of literature examines how political and policy uncertainty affects financial markets and asset pricing. Building on Pastor and Veronesi's (2012, 2013) theoretical model showing that investors demand risk premia to compensate for political uncertainty, recent scholars have demonstrated empirically that a rise in political uncertainty leads to greater price volatility (Brogaard et al. 2020; Liu et al. 2017), higher government and corporate borrowing costs (Gao and Qi 2012; Waisman et al. 2015), shrinking demand for commodities (Hou et al. 2020), more conservative investment behaviors (Jens 2017; Julio and Yook 2012), and fewer initial public offerings (Çolak et al. 2017).

When analyzing the relationship between political uncertainty and financial market activities, scholars have adopted various approaches to operationalize and causally identify political uncertainty. Some studies rely on implied volatility derived from the options market, drawing either from the implied market volatility index (VIX) published by the Chicago Board Options Exchange (CBOE) or realized options contracts (Bekaert et al. 2013; Pham and Nguyen 2022; Völkert 2015). Others develop new measures based on text data to capture specific sources of uncertainty. Manela and Moreira (2017), for example, use frequencies of front-page mentions of economic keywords in the Wall Street Journal (WSJ) to predict news-based market implied volatility (NVIX). Da, Engelberg, and Gao (2015) use proxies for investor sentiments using Google trend patterns. Focusing more exclusively on corporate releases, Hassan et al (2019) construct a new index using textual analysis of call transcripts from corporate earning conferences. One of the most well-cited indexes, the economic policy uncertainty (EPU) index by Baker et al (2016), includes many aspects and captures uncertainty from news, policy, market, and economic factors. Finally, some empirical work examining political uncertainties surrounding specific incidents such as elections and summits have resorted to using binary dummy variables that simply indicate the presence and absence of such shocks (Çolak et al. 2017; Gao and Qi 2012; Julio and Yook 2012).

Although empirical research has largely confirmed theoretical models that predict

investment behaviors and market dynamics in periods of uncertainty, there are still gaps in the literature that remain unaddressed. These gaps pertain to the measurement of political and policy uncertainty, as well as the causal identification of how such uncertainty influences market and investor behaviors. In this paper, we aim to address these gaps and propose a new, more nuanced approach to measure and examine electoral uncertainty. We will leverage firm-level daily option chains and gubernatorial elections data in the United States to show how investors price electoral uncertainty and discuss any potential heterogeneous treatment effects that can be caused by industry trends, levels of diversification, and market capitalization.

1.1 Measuring Policy Uncertainty

The VIX is one of the most widely used measures of uncertainty and expected market volatility and it traces implied volatility of the S&P 500 for 30 calendar days. The same methodology can be used to calculate the implied volatility for any underlying asset for any constant maturity term. One main limitation of the VIX is its scope of coverage, as rather than being too narrow and capturing only market uncertainty (Al-Thaqeb and Algharabali 2019), the VIX absorbs all uncertainty that shapes investors' expectations. This makes it very difficult to disentangle different types of idiosyncratic and systematic uncertainty.

Recent literature cited above has leveraged the power of text data to construct proxies for the state of the world, public sentiments, and the occurrence of economic and political shocks. While these attempts identify a specific source of uncertainty and many have shown predictive power in modeling actual implied volatility, they have failed to distinguish two types of uncertainty: events with predetermined time but unknown consequences and unforeseeable yet high-impact black swan incidents. For the sake of simplicity, we will refer to them as Type I and Type II events in subsequent paragraphs. Events such as elections, summits, and earning calls fall into the first category as investors know ahead of time when they will happen but have no way of knowing what the results will be. The second category includes natural disasters, wars, sudden market crashes,

and events where even the most experienced experts cannot accurately predict the timing and consequences. Theoretically, any news regarding Type I events should reveal more information to investors and lead to a decrease in implied volatility whereas knowledge of any Type II events should induce panic among investors and drive up the implied volatility for an extended period of time.

Any text analysis, by nature, studies the releases of new information into the market. We should therefore expect a drop in implied volatility shortly following a Type I event and a rise in implied volatility after a Type II event. Existing approaches, however, have failed to differentiate between two opposite effects new information can have on investors' expectations and have erroneously equated higher frequency in key economic or political terms with greater implied volatility. Take inflation as an example, an unexpected report on the sudden rise in egg prices caused by an avian flu outbreak should lead to greater market volatility but releases of a Federal Reserve meeting should resolve accumulated uncertainty and drive down implied volatility.

To simplify the measurement problem, researchers have also examined the effects of policy uncertainty by identifying specific events such as national or local elections. Although the binary treatment variable is easy to analyze and interpret, the validity of the findings rests on the assumption that all elections carry implications for political uncertainty and have the same effect everywhere. In reality, however, this assumption is frequently, if not always, violated, as investors may form divergent expectations for different elections. An election between a well-liked incumbent and a newcomer should have much lower uncertainty than a contested election in a swing state. Coding political uncertainty as dummy variables is therefore simple for analysis but not a realistic assumption.

1.2 Causal Effects of Uncertainty

Assuming away the measurement problem unfortunately does not solve all the challenges of analyzing the causal effects of policy uncertainty. To empirically test various theories linking uncertainty and financial outcomes in political and policy contexts, scholars

have either demonstrated that the market demands higher premia and expects higher volatility due to elections (Kelly et al. 2016; Pástor and Veronesi 2012) or shown that firms and investors make more conservative decisions facing higher uncertainty (Çolak et al. 2017; Julio and Yook 2012). On the one hand, existing research establishing the causal relationship between electoral uncertainty and asset pricing has mostly focused on national elections and aggregated indexes that represent trends of the entire market (Goodell and Vähämaa 2013; Li and Born 2006; Nippani and Medlin 2002). On the other hand, much work on firm and investor strategies and behaviors has examined how gubernatorial elections in the United States affect corporate investment decisions (Jens 2017; Julio and Yook 2012). By basing their causal claims on comparisons between firms registered in states with and without gubernatorial elections, these papers assume that gubernatorial elections create political uncertainty in all cases.

This assumption, however, remains under-researched and cannot be substantiated simply by extending results about national elections. First, gubernatorial elections have a much greater variance in expected electoral uncertainty than presidential elections, which tend to be more contested and uncertain. Second, the president has much broader political power than governors, so investors may perceive less uncertainty from a contested governor race compared to a contested national election. Third, most firms in the United States have a diverse geographic presence, so even a contested election in their registered states may have limited impacts on their future operations and revenues, whereas US presidential elections have deep domestic and international implications, impacting even the most diversified companies. Finally, the electoral uncertainty effect may be heterogeneous depending on firm characteristics, and the implied volatility of an aggregated index may not fully reflect the aggregated volatility of the individual assets. Without testing the assumption, the effect between elections and conservative investment behaviors may still be causally identified, but political uncertainty cannot be directly identified as the mechanism explaining such a relationship.

In this paper, we propose to address identified gaps in the literature by testing the political uncertainty assumption for US gubernatorial elections and proposing a more

nuanced approach of measuring electoral uncertainty using poll data that better captures investors' expectations akin to Li and Born (2006), Gemmill (1992), and Goodell and Vähämaa (Goodell and Vähämaa 2013). Building on theoretical models (Pástor and Veronesi 2012, 2013), we hypothesize that:

Hypothesis 1a (H1a) *Compared to firms registered in states without gubernatorial elections, firms registered in states with gubernatorial elections experience greater political uncertainty and an increase in implied volatility due to the election.*

Hypothesis 1b (H1b) *Firms registered in states with higher gubernatorial electoral uncertainty experience greater political uncertainty and a greater increase in implied volatility due to the election.*

2 Methods

2.1 Data

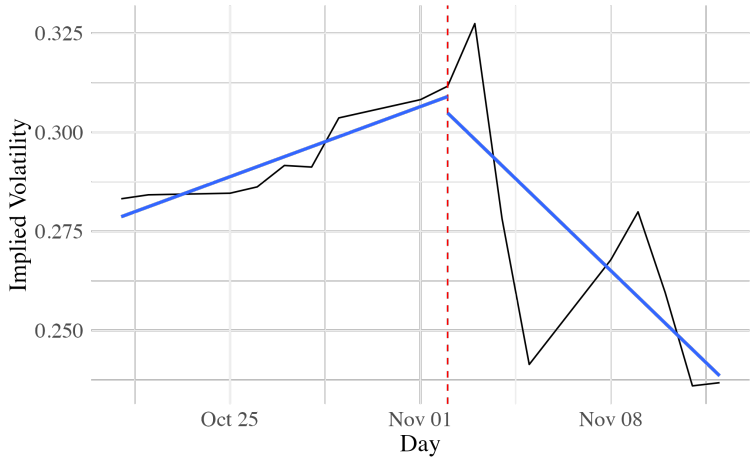
To test our hypotheses, we focus on the 2021 gubernatorial elections in the US. On November 2, 2021, voters in Virginia and New Jersey cast ballots for governor candidates. We select our list of firms from the utility sector of the S&P500 index. We then get the 10-day mean implied volatility from AlphaQuery, which uses the same methodology as the VIX. We choose the 10-day implied volatility because we expect the gradual rise and sudden drop in implied volatility to span a relatively short period of time. We choose to examine elections in 2021 because in even years, presidential or midterm elections happen on the same day as gubernatorial elections, making it more challenging to tease out local election effects. We focus on utility companies in the S&P 500 list because they have more readily available options data and have stronger regional ties and presence compared to companies in other industries and sectors. Given the nature of the utility sector, we see variation in the headquarter of the 29 companies as they serve different geographic locations.

Out of the 29 utility firms, 2 have headquarters in Virginia and 2 in New Jersey. To first test the assumption that gubernatorial elections induce political uncertainty among investors and drive up firms' implied volatility, we follow existing literature and code our treatment as a binary variable, assigning 1 to firms registered in Virginia or New Jersey and 0 otherwise. We then factor in public expectation of election outcomes by using poll data as a proxy for electoral uncertainty. For each day leading up to the election in our sample, we collect opinion poll results released prior to that day and calculate the mean and standard deviation of the vote share of the less favored candidate. We then estimate the probability of their victory by assuming a normal distribution of electoral outcomes. This gives us a continuous treatment variable ranging from 0 to 0.5, with a higher value indicating a more closely contested election and consequently greater expected uncertainty.

To causally test our hypothesis, we run a linear regression on the difference in predicted implied volatility calculated from a regression discontinuity design and a two-way fixed effects difference in difference model.

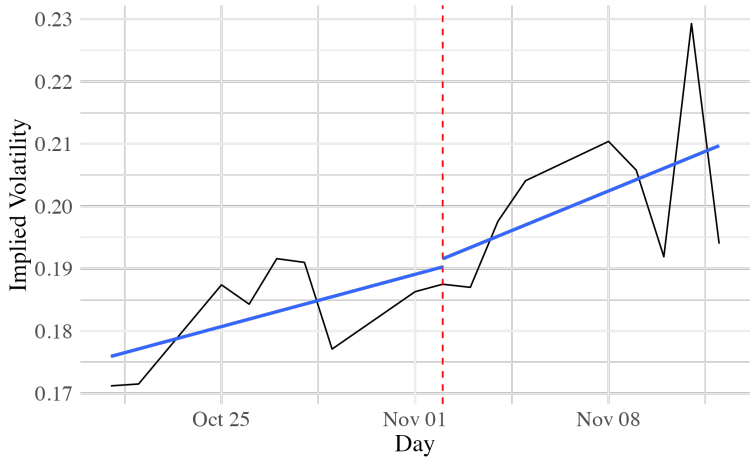
We start by taking a look at two companies in our sample, one in the treatment and one in the control group for our binary variable. AES is a utility company in the S&P 500 and its headquarters are located in Virginia, which had a gubernatorial election in 2021. Therefore, AES is a part of our treatment group for the binary variable, and figure 1 illustrates the company's implied volatility trend around the 2021 gubernatorial election period. The vertical red dotted line is drawn on November 2, the day of the election, and we can see that there is an increase in implied volatility leading up to the election, as predicted by our first hypothesis. After the election, we can see a sudden drop in implied volatility which suggests that the markets respond to the decrease in uncertainty as a result of the election outcomes being announced.

Figure 1: Implied Volatility AES (in the Treatment Group)



An example of a control group observation is XEL, a utility company registered in Minnesota. Figure 1 illustrates the implied volatility of XEL around the election date and we can see that there the trend is largely unchanged around this time. This again alights with our first hypothesis because XEL should experience less political uncertainty caused by gubernatorial elections in states that it is not registered in.

Figure 2: Implied Volatility XEL (in the Control Group)



2.2 Linear Regression and Regression Discontinuity

Theoretically, our data lends itself to a regression discontinuity design. Following Kelly et al (Kelly et al. 2016), electoral uncertainty is reflected in a rise in implied volatility compared to both periods before and after the election. Whereas the buildup is gradual and the timing is unknown, the drop in implied volatility after the election should be

immediate and sudden. We can therefore calculate the election-induced uncertainty by comparing the implied volatility on and immediately after election days.

After performing the regression discontinuity design around the cut-off point, we use the predicted difference in implied volatility as our dependent variable for linear regression to estimate the causal effect between having a gubernatorial election and changes in implied stock volatility. To control for scenarios where electoral uncertainty does not resolve immediately after the release of new information, we calculated two dependent variables, respectively capturing one and two-day(s) change in implied volatility after the election. In all our regression analyses, we include state-fixed effects but for the purposes of readability, we do not include the state coefficients in the table. Our regression formula is specified as:

$$\Delta Y_{ij} = \beta_0 + \beta_1 D_s + \alpha_s + \epsilon_i,$$

where ΔY_{ij} is the change in implied volatility for company i in $j \in \{1, 2\}$ days. D_s is the existence of gubernatorial election (binary treatment model) or expected electoral uncertainty (continuous treatment model) in state s. α_s is the state treatment effect.

The results from our four models are presented in table 1. In models (1) and (3), we use the binary election variable as our independent variable, and in models (2) and (4), we use expected electoral uncertainty as our independent variable. Because expected electoral uncertainty is continuous and bounded by 0 and 0.5, the interpretation of the coefficient needs to be adjusted accordingly. For model (2), for example, a change in electoral uncertainty from 0 to 0.5, which represents an increase from a projected landslide to a toss-up, should lead to an increase in election-induced implied volatility by 0.067, or 6.7%.

Overall, the results of all the models in table 1 show that the companies in states with greater electoral uncertainty experience a decrease in implied volatility after the election results come out. Even a day after the election, the market is responding to the decrease in uncertainty. However, our models suggest that it actually takes longer for the information to be digested and the uncertainty in the market to be resolved.

Table 1: Gubernatorial Elections and Changes in Implied Volatility

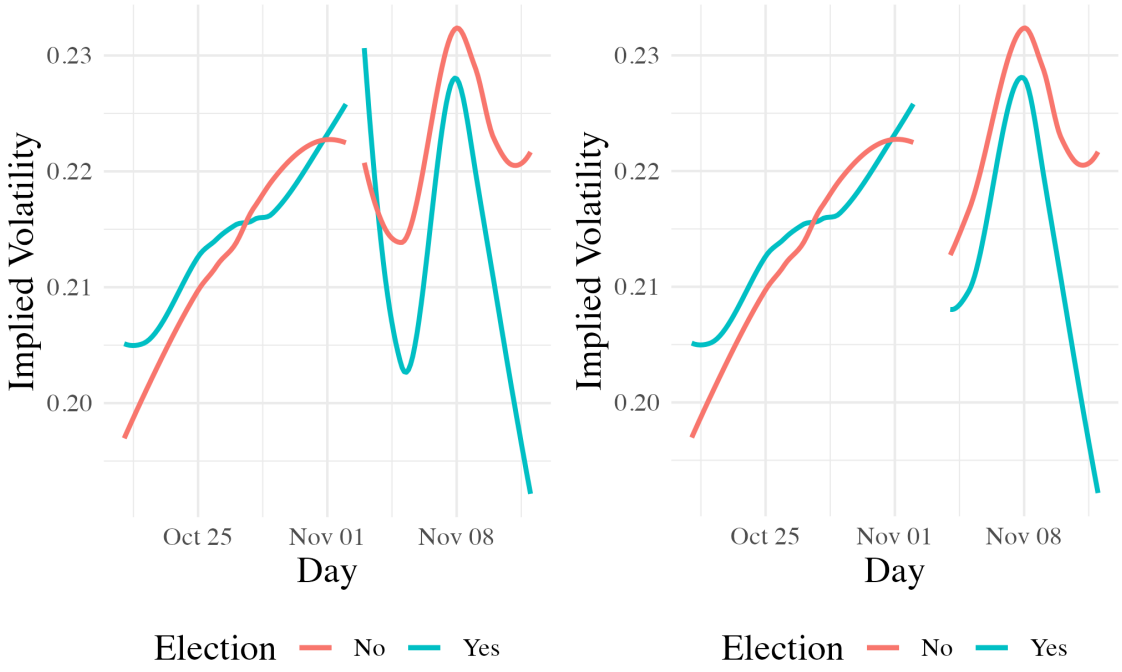
	Dependent variable:			
	Post-Election Change in Implied Volatility			
	One Day Difference		*Two Days Difference*	
Treatment	Binary	Continuous	Binary	Continuous
	(1)	(2)	(3)	(4)
Election	-0.025^{**}	-0.133^{**}	-0.044^{*}	-0.235^{*}
	(0.006)	(0.032)	(0.014)	(0.075)
State FE	Yes	Yes	Yes	Yes
Number of Firms	29	29	29	29
R^2	0.424	0.424	0.359	0.359

*p<0.1; **p<0.05; ***p<0.01

Our finding that the market takes more than a day to adjust to information uncertainty is further illustrated in figure 3. The left graph in Figure 3 illustrates the fluctuation in post-electoral implied volatility within one day following the election, while the graph on the right showcases the same change but within a two-day period. While we see that there is a slight jump in implied volatility one day after the election, we actually see a larger decrease in implied volatility two days after the election, which again suggests that the market takes more than a day to adjust to the information uncertainty.

Overall our results from the linear regression support our hypotheses that gubernatorial elections cause an uncertainty in the market which is captured by an increase in the implied volatility index due to the election.

Figure 3: Post-electoral Changes in Implied Volatility



2.3 Two-way Fixed Effects Difference-in-Difference

In addition to a regression discontinuity, our data lends itself to a difference in difference (DiD) design. Our model, however, differs from a traditional DiD in that the treatment period comes before the control period, but this should not create a problem in our analysis as no unit switch treatment status more than once and all treated units change from being treated to being in the control group on the same day. The DiD formula is specified as:

$$Y_{it} = \beta_0 + \tau D_{it} + \alpha_i + \gamma_t + \epsilon_{it},$$

where Y_{it} is the 10-day mean implied volatility of stock i at time t, D_{it} is the treatment variable, α_i is the unit fixed effect, and γ_t is the time fixed effect.

Table 2 calculates the difference between the mean change in implied volatility before and after the election of treatment and control units. Due to the unique design of our DiD model, the DiD estimate is interpreted as the drop in implied volatility for the treated units between November 2 and November 3 compared to the control group trend. Thus the positive number reported for both models lend support to our hypotheses on the

effects of electoral uncertainty on implied volatility.

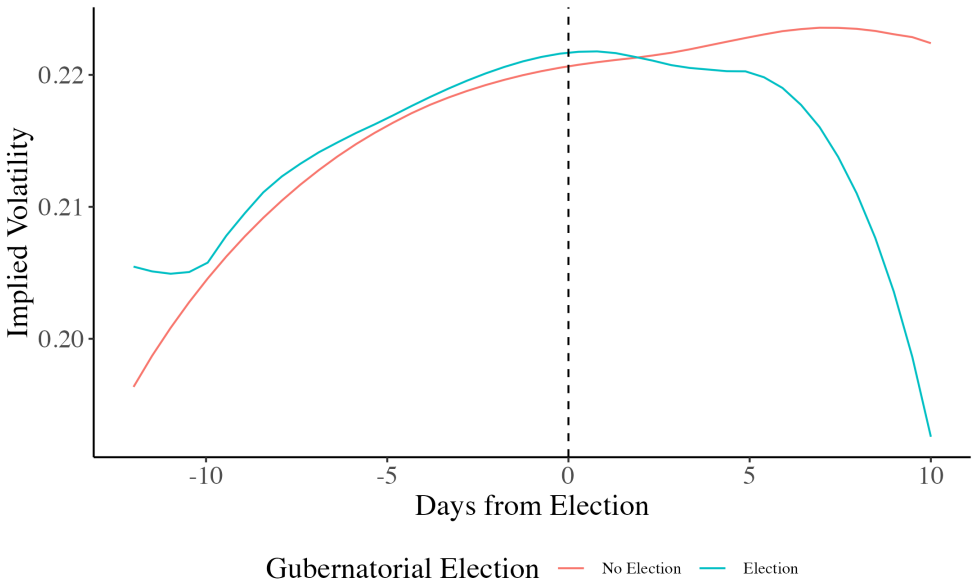
Table 2: Two-Way Fixed Effects with Implied Volatility

	Dependent variable:	
	Implied Volatility	
	Binary	Continuous
	(1)	(2)
Treat	0.012*	0.098*
	(0.005)	(0.038)
Time FE	Yes	Yes
State FE	Yes	Yes
Observations	464	464
R^2	0.744	0.744

*p<0.1; **p<0.05; ***p<0.01

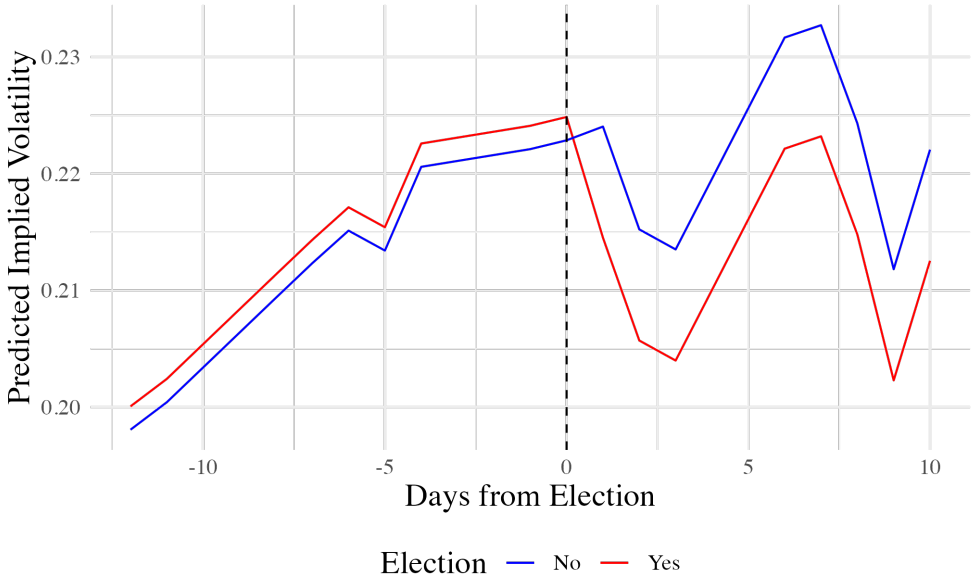
Based on our hypotheses, we anticipate that firms registered in states with elections will be influenced by electoral uncertainty. We expect to observe a higher implied volatility for those firms before the election, and after the election, we anticipate that the electoral uncertainty will be resolved. Therefore, we should be seeing parallel trends after the election but higher electoral uncertainty for treated firms before the election. However, figure 4 does not show parallel trends after the election. The violation of parallel trends could be due to the fact that we have a narrow time frame and only include 10 days after the election. Another reason as to we are not seeing parallel trends could be in part due to the fact that our sample size is very small and so the trends could be driven by outliers. For example, one of the firms in our control group, CMS, had a sudden spike in implied volatility on the last day of our time frame (November 12). CMS experienced an increase in implied volatility by more than 0.3, however, if we extend the period of time, we can see that this peak is short-lived and could be due to a random incident. Nonetheless, this peak is in part driving the rising post-election trend of the control group.

Figure 4: Pre and post-Treatment Trends



Given our difference in difference model for our binary variable, figure 5 illustrates the difference in predicted implied volatility for treated and untreated firms. We can see that for firms registered in states with a gubernatorial election, our model predicts a greater decrease in implied volatility after the election.

Figure 5: Predicted Implied Volatility



Overall, our findings from the difference in difference model align with our hypothesis. But it is important to highlight that we need more data and a longer post-election period

to establish parallel trends.

3 Conclusion

In conclusion, our preliminary results suggest that the market is responding to political uncertainty resulting from gubernatorial elections. Both the linear regression model and the difference-in-difference design support our hypotheses that higher gubernatorial electoral uncertainty causes a greater increase in implied volatility due to the election.

One limitation in our current study is the small sample size, as manually collected data on AlphaQuery is very inefficient and error prone. Moving forward, we plan to gain access to the complete dataset on option contracts for all publicly listed firms in the US. This will enable us to expand our sample by including more companies in our sample. If possible, we hope to collect data on the full sample of public firms in the US that have consistent option data. This will allow us to examine how other factors, including geographic diversification, market capitalization, and sector, affect investors' perception of electoral uncertainty. We also plan to include more years of observations and greater variation in our treatment variables.

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