Political Fear and Loathing on Wall Street: Electoral Risk Hedging in the United States (1996-2020)

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Abstract

To the extent that asset prices are responsive to policy shifts, hedging against election risk should be valuable to investors. This study uses option prices to investigate market expectations of electorally-induced financial turbulence in the United States between 1986 and 2020. The evidence reveals that the sensitivity of asset prices to U.S. national election outcomes is quite large, statistically significant, and varied substantially over time. A comparison between the electoral risk estimates (based on option prices) and the actual post-electoral volatility of stock market returns, indicates that hedging against election risk has become increasingly expensive over time. The results also suggest that market sentiment has pushed options prices well above their expected level based on election forecasts during the Trump era. These findings imply that option sellers have been able to profit from investors' fears of large post-electoral price changes in recent years.

Keywords: Political Risk, Elections, Option Prices

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Introduction

On the day of the 2020 U.S. presidential election, the Chicago Board Options Exchange (CBOE) Volatility Index – known as Wall Street's "fear gauge" – stood at 35.55, indicating that anxiety loomed large in the minds of investors. By the end of the week, however, it sank 30%, to 24.86. This drop in the index suggests that, despite president Trump's refusal to commit to a peaceful transfer of power, investors became less worried about politically-induced market turbulence after the election day had passed. It also reveals that the market had more than priced in political risk. The index uses as inputs the prices of financial derivatives, called options, that can be used to hedge or speculate on future price changes.[1] The combination of high pre-election premiums and lower-than-expected post-electoral volatility – reflected in the index reversal– rendered selling, rather than buying, options a profitable trading strategy on the days surrounding the election.

Several studies have examined the impact of electoral outcomes on equity market valuations (Herron 2000; Leblang and Mukherjee 2004; Füss and Bechtel 2008; Sattler 2013).[2] Most of this research, however, examines the effect of electoral outcomes on realized, or *post-electoral*, changes in asset prices. I depart from this work by focusing on investors' *ex ante* beliefs that an election outcome will foster increased variability in asset prices. Specifically, I use option prices on dates leading up to and passing through a national election to investigate the anticipated price of effects of national elections. Options are forward-looking contracts, and thus account for the market's forecast of likely movements in asset prices. Therefore, I believe that this strategy is an improvement on previous research.

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[1]The buyer of an option pays the seller a certain sum, called the *premium*, for the right to buy or sell a security at a predetermined value, called the *exercise* price, by a certain date. If the difference between the underling security's price and the exercise price exceeds the premium, an option holder will turn a profit. Otherwise, the option will expire worthless, but the loss to its owner will be limited to the premium paid.

[2]See Ferrara and Sattler (2018) for a recent survey of the political science research on the effect of politics on financial markets. See also Wisniewski (2016) for a survey of the literature on election risk in the fields of finance/economics.

The effect of pre-scheduled news releases on asset prices has also been the object of inquiry, including investors' reactions to (i) earning announcements (Patell and Wolfson 1979 & 1981; Ederington and Lee 1996; Dubinsky et al. 2019); (ii) Federal Open Market Committee (FOMC) meetings (Chen and Clements 2007; Vähämaa and Äijö 2011; Gospodinov and Jamali 2012); as well as (iii) monthly employment report, CPI report, and PPI report dispatches (Nikkinen and Sahlström 2004). Similar to these events, national elections usually have a predictable schedule. In this case, an important source of uncertainty is the electoral outcome, which is only revealed with certainty after the election concludes. As such, the impact of elections on option-implied volatility has also received scholarly attention. For instance, Gemmill (1992) documents that the implied volatility of the FTSE 100 index increased substantially before the 1987 British parliamentary election.[3] Goodell and Vähämaa (2012) and Mnasri and Essaddam (2021) examine the implied volatility of the S&P 500 around US presidential elections between 1992 and 2008. Using cross-national data for the period 1990-2012, Kelly, Pastor and Veronesi (2016) show that one-month at-the-money (ATM) options whose lives span national elections tend to be more expensive than neighboring ones. Finally, Carvalho and Guimaraes (2018) study the effect of the 2014 Brazilian presidential election on options prices of state-controlled companies.

My contribution is to investigate how the electoral risk is priced in the option market using data on all national elections in the United States between 1986 and 2020. Following Dubinsky et al. (2019), I derive an analytical estimator of *electoral risk* using changes in market expectations of asset price movements around elections. The evidence shows that the sensitivity of asset prices to election outcomes is considerable, statistically significant, and varies over time. The results reveal that electoral price risk nearly doubled during the period between 2012 and 2020, relative to the 1986-2010 era. These findings suggest that hedging against election risk has become more expensive over time.

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[3]Gwilym and Buckle (1994) update Gemmill's analysis for the 1992 British parliamentary election.

The empirical results raise the question of whether the electoral outcomes of the past decade warranted higher option prices. A comparison between the electoral risk estimates (based on option prices) and the actual post-electoral volatility of stock market returns, indicates that exposure to post-electoral price movements did not fetch a significant premium between 1986 and 2010. After 2010, however, the actual post-electoral price change amounts to 3.3% on average, while the average post-electoral price jump estimated from option prices is 5.34%. This difference implies that traders could profit from selling options around elections during this latter period. To further explore the profits that could be obtained from market expectations of electorally-induced financial turbulence, I consider the returns to different volatility trading strategies. The analysis reveals that selling *electoral insurance*, in the form of variance swaps, has been extremely lucrative in the past 10 years. I further probe into the expensiveness of options around elections, by looking at the profitability of positions designed to benefit from low, rather than large, post-electoral volatility. The analysis confirms that, in recent years, option sellers had an opportunity to profit from investors' fears of large post-electoral price changes.

Finally, I consider whether option prices were consistent with electoral forecasts during the 2016 and 2020 presidential elections. My findings indicate that, in the month leading to the 2016 election, option prices overestimated the probability of a Trump victory by an average of approximately 11 percentage points (28.7% compared to the 17.8% winning chance predicted by the polls). In the 2020 election, the evidence suggests that, during the last month of the campaign, option prices indicated a 48% chance of Trump refusing to vacate the Oval Office should he lose the election, compared to 44% according to prediction markets. In this case, market sentiment pushed options prices well above their expected level based on election forecasts.

Overall, my results contribute to an emerging literature that cuts across the fields of political science and finance (Ferrara and Sattler 2018). They reveal that electoral risk

premiums have become increasingly larger over time. They also indicate that while market participants loath electoral uncertainty, it is downward post-electoral jumps in stock prices what they fear the most. In addition, my analysis provides direct evidence connecting election outcomes to political risk premiums. I find that the greater sensitivity of asset prices to electoral outcomes has lead to a significant increase in how much investors have to pay to insure themselves against electoral risk.

The remainder of the paper is organized as follows. In Section 1, I investigate how electoral risk is priced in the options market. In Section 2, I analyze electoral risk premiums in the United States during the period between 1986 and 2020. I further examine electoral risk pricing during the Trump era in Section 3. A final section concludes.

1   Election Outcomes and Asset Prices

Investors concerned about non-commercial risks need to consider their exposure to political events that may affect the value of their assets. These political risks can originate in specific government actions, such as laws or regulations. They can also arise from policy shifts. Recent research has examined how market valuations respond to electoral uncertainty. For example, Carnahan and Saiegh (2021) examine the effect of electoral outcomes on asset prices. They model traders' decisions as a sequential sampling problem, where the optimal stopping strategy is driven by information-gathering costs and an investment's suitability to the future state of the world. Their findings indicate that risk-neutral traders' optimal investment strategies depend on: (1) their ability to make an accurate electoral forecast; and (2) the prospective losses associated with placing a bet on the wrong candidate.

While some traders may postpone their investment decisions until the electoral uncertainty is resolved, others may use options to hedge their bets. Pastor and Veronesi (2013) develop a model in which stock prices respond to political signals. In its original version,

the government decides which policy to adopt and investors are uncertain about the future policy choice. Kelly, Pástor, and Veronesi (2016) interpret the model as one of democratic elections: investors are uncertain about who will be elected. Either way, the model implies that hedging against election outcomes should be valuable (Pastor and Veronesi 2013: p. 534-535). The issue then boils down to how the *election risk* is priced in the option market.

1.1 Election Risk Pricing

Options are forward-looking contracts. As such, their prices should provide an "early warning" of how the value of their underlying assets will react to impending elections whose actual outcome is not yet known. Market efficiency often precludes investors from predicting the direction of assets' price changes associated with a given election outcome. Investors, however, usually anticipate that increased price variability will ensue from the revelation of the winning candidate's identity (Białkowski, Gottschalk, Piotr 2008; Boutchkova et al. 2012).

The market's forecast of a likely movement in a security's price, usually known as *implied volatility*, can be derived from option prices. Consider an extension of the Black-Scholes model with a single price jump occurring immediately after the election date, whose size is normally distributed with a volatility of $\sigma_e^{\mathbb{Q}}$ (where $\mathbb{Q}$ is the risk-neutral probability). Then, Appendix A shows that the implied volatility of an option at time t with expiry T and strike K, faced with an election at period T_e, is given by:

$$I(t; K, t) = \begin{cases} \sqrt{\sigma^2 + \frac{(\sigma_e^{\mathbb{Q}})^2}{T-t}} & \text{if } 0 \leq \text{t} < T_e \\ \sigma & \text{if } T_e \leq t < T, \end{cases} \tag{1}$$

where σ is the diffusive volatility (Leung and Santoli 2014).

As Dubinsky et. al (2019) note, this extension of the Black-Scholes model has two important implications: (1) IVs increase continuously prior to release of new information; (2) IV

discontinuously falls after the information is released. Therefore, there should be a detectable pattern in the changes of implied volatility before and after elections.

Figure 1 shows the expected volatility of the S&P 500 index in a window of seven trading days centered on the 2020 United States presidential election (October 29th-November 6th).[4] The ordinate shows the implied volatility of S&P options calculated using at- and out-of-the-money puts and calls with more than 2 days and less than 9 days to expiration.[5] The implied volatility increased rapidly from 45.2% to over 56% as time approached the election. However, once the election outcome was revealed – and its effects were assimilated into stock prices–, the volatility dropped significantly to 37.8% (and subsequently to 23.7%).

Figure 1: Option-Implied S&P Volatility
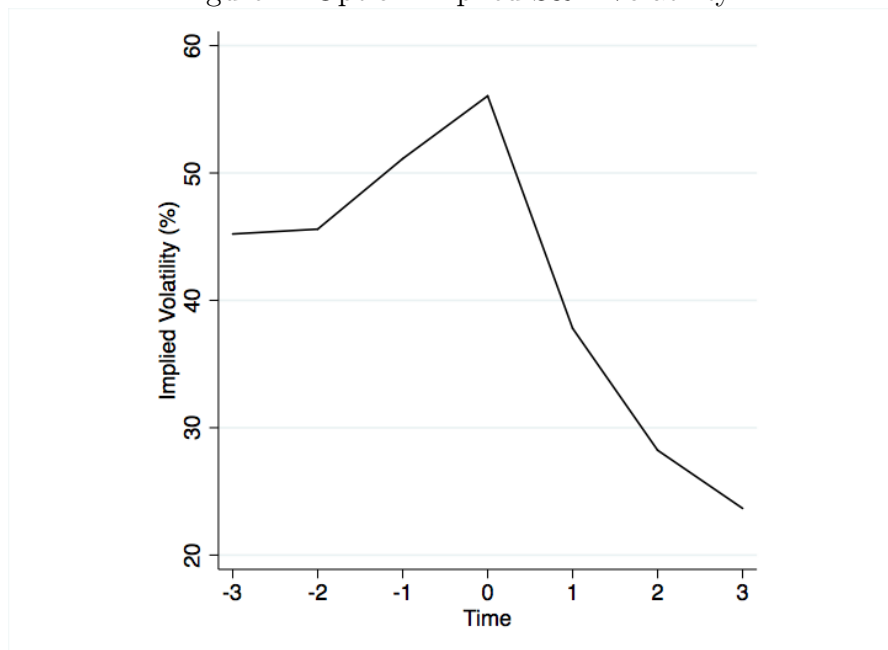
The pattern uncovered in Figure 1 suggests that the anticipated stock price reaction (in terms of variability) to election outcomes can be detected in pre-electoral option prices. It

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[4]The days are identified in the horizontal axis as 3,-2,-1, 0, 1, 2,3, with day zero denoting the trading day immediately before the identity of the winning candidate is revealed (i.e. November 3rd, election day).

[5]The data corresponds to the near term SPX option series used by the Chicago Board Options Exchange (CBOE) to calculate their 9-Day Volatility Index (VIX9D). These include PM-settled weekly SPX options expiring on Friday November 6th, 2020 and on Friday November 13th, 2020. See https://www.cboe.com/us/indices/dashboard/VSTN/

also implies that, as discussed in Dubinsky et al. (2019), it is possible to derive an analytical estimator of the *electoral* price risk based on implied volatility dynamics around elections.

Let σ_{IV,t_1} and σ_{IV,t_2} represent the implied volatilities of two options at times t_1 and t_2, with identical maturity at time T. Assuming that the identity of the winning candidate is revealed after the close on date t_1 (or before the open on the next trading date, t_2), then the annualized implied variance should be $\sigma^2 + \frac{(\sigma_e^{\mathbb{Q}})^2}{T-t}$ just before the election, and σ^2 after the election. Applying equation (1) and solving for $\sigma_e^{\mathbb{Q}}$, one can obtain the following estimator of electoral risk based on the post-electoral decrease in implied volatility:

$$\sigma_e^{\mathbb{Q}} = \sqrt{(T - t)(\sigma_{IV,t_1}^2 - \sigma_{IV,t_2}^2)} \ . \tag{2}$$

Consider the changes in the expected volatility of the S&P 500 index around the 2020 U.S. presidential election illustrated in Figure 1. The implied volatility fell from 56% on Tuesday November 3rd to 37.8% in the following day. This drop in implied volatility implies a post-electoral price change of $\sigma_e^{\mathbb{Q}} = 5.62\%$.

2 Electoral Risk in the U.S.

To examine the impact of national elections on asset prices in the United States, I rely on the the estimator in Equation (3), and changes in implied volatility around elections using various indexes developed by the CBOE. For example, its VIX index provides a 30-day expectation of volatility given by a weighted portfolio of out-of-the-money European options on the S&P 500. While the VIX index is reported for a 30-day maturity, the formulas used to calculate its value are valid at any horizon. In addition, the CBOE uses the same methodology to compute volatility indexes on broad-based stock indexes, exchange traded funds, as well as

individual stocks and commodities.[6] For each of these indexes, the sample is restricted by CBOE data availability. For instance, the S&P 500 9-Day Volatility Index (VIX9D) starts on January 4th, 2011. Nonetheless, the S&P 30-day index, the price history is available from January 2nd, 1986 to the present. Therefore, it is possible to examine electoral price risk for national elections in the United States between 1986 and 2020. It should also be noted that, from Equation (1), $\sigma_{IV,t_1}^2 > \sigma_{IV,t_2}^2$ must hold. Otherwise, the estimator is not defined. Elections on which the hypothesis of a decreasing implied volatility after the identity of the winning candidate is violated are thus excluded from the analysis.

Table 1 provides electoral price risk estimates for different asset classes. Jensen's inequality implies that the average of the standard deviations is less than the square root of the average. Therefore to be conservative, and following Dubinsky et al. (2019), I average the estimators in volatility units. I report summary statistics over the sample period from 1986 to 2020, including the average (Mean), and the standard error (SE) of all observations without errors. The column Error counts the number of elections on which the hypothesis of a decreasing implied volatility after the identity of the winning candidate is announced is violated. The last column provides the number of elections under consideration (Obs.).

The empirical evidence indicates that national elections in the United States have an effect on diversified portfolios, including those offering exposure to stocks in Emerging Markets (MSCI EEM), as well as specific asset classes (such as oil or gold). Using the Wilcoxon signed-rank test, the null that large post-electoral price moves are not priced in options can be rejected for most cases. The two exceptions (marked in grey) are given by the 30-day S&P 500 between 1986-2010, and the MSCI EAFE that provides exposure to companies in Europe, Australia, Asia, and the Far East.

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[6]For the technical details on the calculation of the VIX index, please see the CBOE VIX white paper: https://cdn.cboe.com/resources/vix/vixwhite.pdf.

Table 1: Electoral Price Risk, 1986-2020

Asset	Maturity	Mean	S.E.	Error	Obs.	Period
All Elections						
S&P 500	30-day	2.99	0.41	6	12	1986-2020
S&P 500	30-day	2.37	0.31	5	8	1986-2010
S&P 500	30-day	4.25	0.81	1	4	2012-2020
S&P 500	9-day	4.37	0.82	1	4	2012-2020
Russell 2000	30-day	3.81	0.65	1	5	2010-2020
DJIA	30-day	3.72	0.59	1	5	2010-2020
NASDAQ-100	30-day	3.72	0.69	1	5	2010-2020
MSCI EAFE	30-day	3.13	0.63	3	4	2008-2020
MSCI EEM	30-day	4.59	0.53	2	3	2012-2020
Crude Oil ETF	30-day	3.79	0.84	1	5	2010-2020
Gold ETF	30-day	2.88	0.26	1	5	2010-2020
Presidential Elections Only						
S&P 500	30-day	3.64	0.56	3	6	1988-2020
S&P 500	30-day	2.81	0.27	2	4	1986-2010
S&P 500	30-day	5.31	0.42	1	2	2012-2020
S&P 500	9-day	5.57	0.11	1	2	2012-2020

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The results also reveal that the sensitivity of asset prices to election risk is quite large. To place these estimates in context, consider the S&P 500 intra-day returns between 1986 and 2020 (excluding the day immediately after a national election). Their mean value was 0.04%, with a standard deviation of 1.16%. The estimated post-electoral price change is substantially higher, with a variance ratio larger than six, on average. A simple value at risk (VAR) calculation indicates that the probability that a hypothetical USD 100 investment in the S&P 500 would lose more than USD 3 in a single day during this period was roughly

1.2%. The evidence in Table 1 also reveals that electoral risk varied substantially over time, ranging from 2.37% between 1986 and 2010 to approximately 4.25% during the 2012-2020 period, respectively. In addition, the average electoral risk is higher for presidential, rather than congressional races. Finally, an examination of the cases where $\sigma^2_{IV,t_1} < \sigma^2_{IV,t_2}$ (the column *Error*), indicates that their frequency was much higher during the 1986-2010 period than in the 2012-2020 era. These last two findings suggest that most elections with negligible risks were concentrated in contests with relatively inconsequential outcomes.

2.1 Electoral Volatility and Risk Premiums

The evidence presented in the previous section indicates that election risk in the United States is routinely priced by the option market. The findings also reveal that, in the last decade, insuring against election risk has become more expensive. An important question is whether the electoral outcomes of the past ten years warrant the higher option prices. If options market participants correctly forecast the magnitude of the post-electoral price changes, then no significant difference between the expectation of future realized variance under the risk-neutral measure and the expectation under the physical measure should exist. Otherwise, a discrepancy between them would indicate that investors demand a premium for bearing the electoral risk of an option position (Bollerslev, Tauchen and Zhou 2009).

How much compensation did investors require in the form of electoral risk premium? A comparison between the option-implied electoral risk estimate ($\sigma^{\mathbb{Q}}_e$) and the realized post-electoral volatility of returns can shed some light on this question. Following Dubinsky et al. (2019), I compute the expected 1-day volatility derived from option prices by adding to the post-electoral jump volatility 1 day's diffusive volatility, and compare it to the realized volatility (measured as squared returns). In the case of the S&P 500, the average actual jump (3%) is indistinguishable from the average estimated post-electoral jump for the 1986-2010

period. After 2010, however, the average actual jump amounts to 3.3%, while the average estimated post-electoral jump is 5.34%, implying an average risk premium of roughly 204bps.

2.2 Variance Swap Returns

The post-2010 electoral risk premiums suggest that option traders had an opportunity to profit from investors' fears of large post-electoral price movements. To further examine this issue, I analyze S&P 500 variance swap returns between 2011 and 2020. A variance swap is an instrument which allows investors to trade future realized (or historical) volatility against current implied volatility.

Selling a variance swap will be profitable if the market delivers less realized volatility than that implied by the option's exercise price. It can thus be likened to selling insurance, with a steady income punctuated with occasional large drawdowns. Conversely, the buyer of a variance swap will profit if the subsequent realized volatility is above the level set by the option's exercise price.[7] Therefore, buying a variance swap is like buying insurance: paying a relatively small premium for a potentially large payout if things go wrong, but expecting to forfeit some, or all, of the premium on most occasions. Given these insurance-like characteristics, long volatility positions on an underlying index (such as the S&P 500) are usually biased to make a loss, while short volatility positions are, on average, profitable. This bias is referred to as the volatility risk premium.[8]

Consider the following hypothetical variance swap contract. One party agrees to pay a fixed amount at maturity (i.e. the price of the variance swap), in exchange for a payment equal to the sum of squared daily log returns of the S&P 500. The payoff, $p_{\tau,m}$ at expiration

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[7]Variance swaps, however, are convex in volatility: a long position profits more from an increase in volatility than it loses from a corresponding decrease.

[8]If an investor has a long position, it means that the investor has bought and owns the variance swap. If the investor has a short position, it means that the investor sold the variance swap to someone else.

of a contract initiated at time τ and with maturity m, and Strike Price, $SP_{\tau,m}$, is given by:

$$p_{\tau,m} = VN_{\tau,m} \times [(RVS_{\tau,m})^2 - (SP_{\tau,m})^2]$$

where VN, the Variance Notional, is determined as:

$$VN_{\tau,m} = \frac{Vega\ Notional}{2 \times SP_{\tau,m}},$$

and the Realized Volatility Strike of the S&P 500 is calculated using the formula:

$$RVS_{\tau,m} = \sqrt{\frac{252 \times \sum_{i=\tau+1}^{\tau+m} \left(ln\frac{Index_i}{Index_{i-1}}\right)^2}{m}} \times 100.$$

I am interested in the reward required by a risk averse investor for being exposed to the post-election jump risk. Most market participants think in terms of volatility. Therefore, the profit/loss of holding a variance swap is usually expressed in *vega notional*, which represents the average profit or loss for a 1% (1 vega) change in volatility.[9] Following Kelly, Pastor and Veronesi (2016), I compare the payoffs of variance swap contracts in a "treatment" group to those in two neighboring "control" groups. The first group contains contracts whose expiration includes the day when the outcome of a national election is revealed. The latter two consist of contracts initiated around elections, but whose expiration excludes that date. Denoting the trading day immediately following the identity of the winning candidate is revealed as $t = 1$, the treatment group includes the payoffs of contracts, $p_{\tau,m}^{Treat}$ initiated at time $\tau \in \{-m - t < \tau < t\}$. The pre-treatment group includes the payoffs of contracts, $p_{\tau,m}^{Pre}$ initiated at time $\tau \in \{-2m - t < \tau < -m\}$, and the post-treatment group is consists of the

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[9]So, for instance, suppose a 9-day variance swap is stuck at 20 with a vega notional of USD 100. An investor holding a long position will be delivered the difference between the realised variance over the next seven trading days and the current strike price, multiplied by the variance notional. If the index only realises 15%, the payoff will be equal to $100 \times \frac{15^2 - 20^2}{40} = -437.5$, a loss of 4.375 vegas.

payoffs of contracts, $p_{\tau,m}^{Post}$ initiated at time $\tau \in \{t - 1 < \tau < m + 1\}$. While the contracts in each of these groups have different expiration dates, all of them have the same time to maturity. Therefore, the average payoffs for each of these groups are fully comparable.

Extensive data on quoted prices for S&P 500 variance swaps across multiple national elections are difficult to obtain. But, the VIX index is equal to the square root of a variance swap on its underlying, the S&P 500. Therefore, variance swap strikes can be easily inferred from VIX levels. To minimize the presence of contaminating information, I restrict my attention to a small window around each electoral contest. Specifically, I use the CBOE 9-Day Volatility Index (VIX9D), which is based on the entire strip of options contracts, as a proxy for the prices of variance swaps on the S&P 500 that mature in seven trading days.[10] Because the VIX tends to trade slightly above variance swap prices, and to account for capped variance swaps (which usually trade below uncapped variance swaps), I estimate the variance swap strike prices at 175bps below the VIX9D. Using these estimated values of $SP_{\tau,m}$, the sum of squared daily log returns of the S&P 500, and equation (4), I calculate the payoffs $p_{\tau,m}$ for the variance swaps contracts included in the "treatment" group as well as the two neighboring "control" groups.

Figure 2 shows the average profit/loss (p/l) of long variance swap contracts initiated around the five national elections that took place in the United States between 2011 and 2020. The vertical axis displays the the average p/l of the variance swap contracts, expressed in terms of vega notional. The contract initiation dates, τ, are shown in the horizontal axis, with day one denoting the trading day immediately after a national election. Therefore, while the calculation of payoffs of contracts initiated at $-8 < \tau < 1$ (treatment group) includes price changes in the S&P 500 on the day when the identity of the winning candidate is revealed, contracts initiated outside of that window (control groups) do not. The solid

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[10]The CBOE uses calendar days rather than trading days in the VIX calculations, thus the discrepancy between 9 and 7 days.

circles, connected by a black line, indicate the average p/l of contracts in the treatment group, whereas the p/l of the contracts in the control groups are represented by the hollow circles, connected by a grey line. For reference, the average p/l of long variance swaps of in the full sample (excluding the three-weeks window around national elections used to calculate the average payoffs in treatment/control groups), -1..63, is represented by the horizontal dashed grey line.

Figure 2: P/L of Long Variance Swap Contracts around Elections, 2012-2020
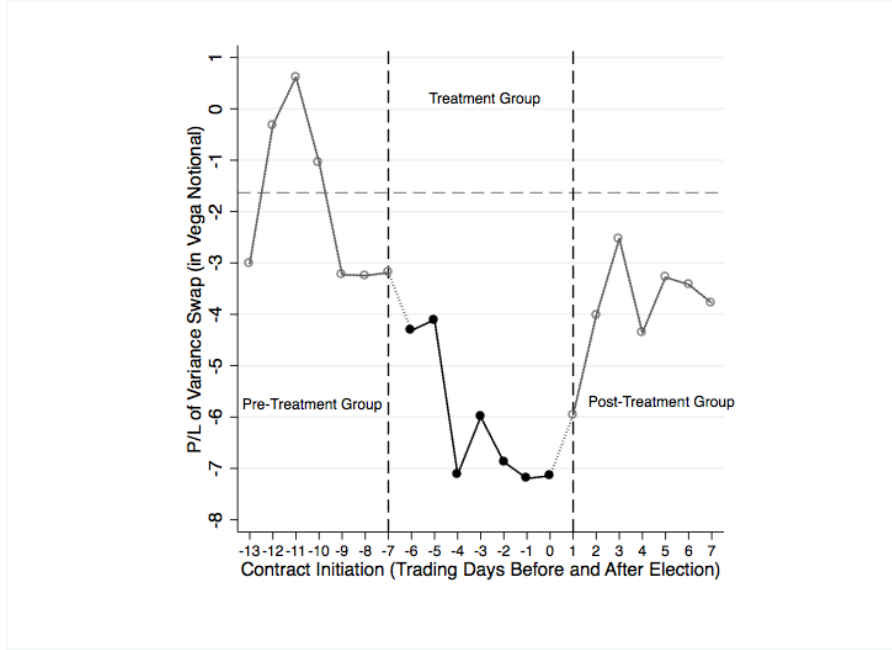
The evidence reveals that the average loss of long variance swap contracts with an expiration date immediately preceding the resolution of electoral uncertainty (i.e. initiated at $\tau = -6$) was -3.19, compared to -4.31 for a similar variance swap initiated the day after. Likewise, the average loss of long variance swaps initiated the day when the identity of the winning candidate was revealed (i.e. $\tau = 1$) was -5.96, compared to -7.14 for a similar one initiated the day before. This loss of roughly one additional vega (illustrated by a dotted grey line) represents the average exposure to the election outcome. The evidence also indicates that the bias of long volatility positions on the S&P 500 in the treatment group were

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larger (i.e. the expected returns from receiving the fixed rate in variance swaps were more negative), compared to variance swaps in the control groups. This electoral volatility risk premium (EVRP) can be calculated as:

$$EVRP = \overline{p_{\tau,m}^{Treat}} - \frac{1}{2}(\overline{p_{\tau,m}^{Pre}} + \overline{p_{\tau,m}^{Post}}), \tag{3}$$

where $\overline{p_{\tau,m}^{Treat}}$, $\overline{p_{\tau,m}^{Pre}}$, and $\overline{p_{\tau,m}^{Post}}$ are averages of the payoffs associated with the variance swap contracts included in the treatment, pre-treatment, and post-treatment groups, respectively. The average EVRP across all five elections amounts to -3.17 (t-statistic=-3.49), indicating that variance swap holders were willing to pay a larger premium to hedge against electoral price risk during the 2011-2020 period. This finding is not only statistically but also economically significant. Selling volatility has historically been profitable; but selling *electoral* insurance in the past 10 years has been even more lucrative, raking in more than six times the variance swap contract's vega notional.

2.3   Electoral Volatility Trading

The returns from long variance positions – which are typically negative–, should increase in absolute terms (i.e. they should be even more negative) whenever variance swap strike levels are excessively high. To further probe into the expensiveness of options around elections, following Gao, Xing, Zhang (2018) I look at the profitability of a *strangle*. This is a trading strategy that involves combining a put and a call on the same asset, with different exercise prices – not necessarily at-the-money – and time to maturity.[11] This strategy is a particularly appealing when one expects a security or an entire index to make a large move following an event, but one is unsure about the direction of this move. National elections fit this

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[11]In the case of a strangle, the exercise price of the put should be less than the exercise price of the call. When the put and the call have the same exercise price, the position is called a *straddle*.

description very well. They are recurring, have a predictable schedule, and have the potential to trigger large price movements. It is often difficult, however, to predict the direction of the movement.

Suppose someone considers that option prices are overestimating the magnitude of a post-electoral price movement. She could then write a strangle (i.e. sell both calls and puts) ahead of the election to capture the volatility premium impounded in option prices. Her profit will be limited to the total premiums received, whereas her potential loss will be unlimited if the price of the underlying asset rises, and substantial if it falls. Therefore, the strategy's success depends on the magnitude of price movement (regardless of its direction) and the change in implied volatility. If the options market had correctly priced the post-electoral price change, then she will likely lose money. In contrast, her position will be profitable if the price reaction of the underlying asset to the revelation of the winning candidate's identity is smaller than what is implied by the (combination of both) option prices.

I calculate average strangle returns around U.S. national elections for the period between 2006 and 2020 using the CBOE's VIX Strangle Index (VSTG). The index tracks the value of a hypothetical portfolio which overlays a short strangle of VIX options and a long VIX call on one-month Treasury bills.[12] I consider positions that are opened and closed over different windows around the election day. Based on the implied volatility dynamics around elections uncovered above, I focus on buy-and-hold strategies that cover the running up of electoral uncertainty until electoral uncertainty is partially or fully resolved. Specifically, the starting date is chosen on day -2, and the ending dates are either days 0, or 1, with day zero denoting the trading day immediately before the identity of the winning candidate is revealed. So, for

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[12]VIX options did not exist until 2006, so the VSTG is only available after March 21st, 2006. The short VIX put and call have strikes set at the 5th and 95th percentile values of the forward distribution of VIX. The long VIX call has a strike set at the 99th percentile. The number of capped short VIX strangles is set to ensure that 80% of the value of the portfolio at the previous rebalancing date is preserved. For more details on the calculation of the index, please go to: https://cdn.cboe.com/api/global/us_indices/governance/VSTG_Methodology.pdf.

the strategy over [2,0], the VSTG index is bought on day -2 (the Friday before the election) and sold on election day (a 3-day holding period). In the strategy over [2,1], the VSTG index is also bought on day -2 (the Friday before the election), but it is sold the day after the election day (a holding period of 4 days).

The distinction between the ending dates should capture two different effects around elections: the pre-electoral effect and the post-electoral one. The first effect is relevant for the strategy ending on day zero, which is strictly before election outcomes are revealed. The value of the VSTG index might increase before the election day due to electoral uncertainty (an unforeseen outcome). The second effect should capture the actual exposure to the election outcome. If the magnitude of the post-electoral price change is small enough, the strangle returns will be positive, leading to a further increase in the VSTG index.

Figure 3 shows the returns associated each of the two hypothetical VSTG trading strategies for all the national election held in the United States between 2006 and 2020. The dashed line corresponds to the strategy over [-2,0] (i.e. the pre-electoral effect), and the solid line to the strategy [-2,1] (i.e. the post-electoral effect). The average return of the [-2,0] strategy for the five elections that took place between 2006 and 2014 was -0.003%, compared to 1.66% (with a significant t-statistic of 2.84) for the three following ones (2016, 2018, and 2020). In the case of the [-2,1] strategy, the average four-day return for the five elections that took place in the 2006-2014 period was 0.01%, but rose to 2.95% (with a significant t-statistic of 4.60) thereafter. As a benchmark, the average return for a 3-day (4-day) holding period over all trading days (excluding the positions opened/closed around the election day) was 0.059 (0.088) between 2006 and 2014, and 0.001 (0.001) in the post-2014 period.

The post-2014 returns associated with the two hypothetical VSTG *electoral* trading strategies are both statistically as well as economically significant, indicating that option prices overestimated both electoral uncertainty as well as post-electoral price jumps in the last

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three U.S. national elections. In the former case, there is usually not much that the invest-ment community does not already know in the final two days before the contest regarding the election's outcome. Nonetheless, as Figure 3 shows, while the option market slightly un-derestimated the likelihood of Barak Obama's victory in 2008, it significantly overestimated electoral uncertainty in the Trump era.

Figure 3: VSTG Index Returns, 2006-2020
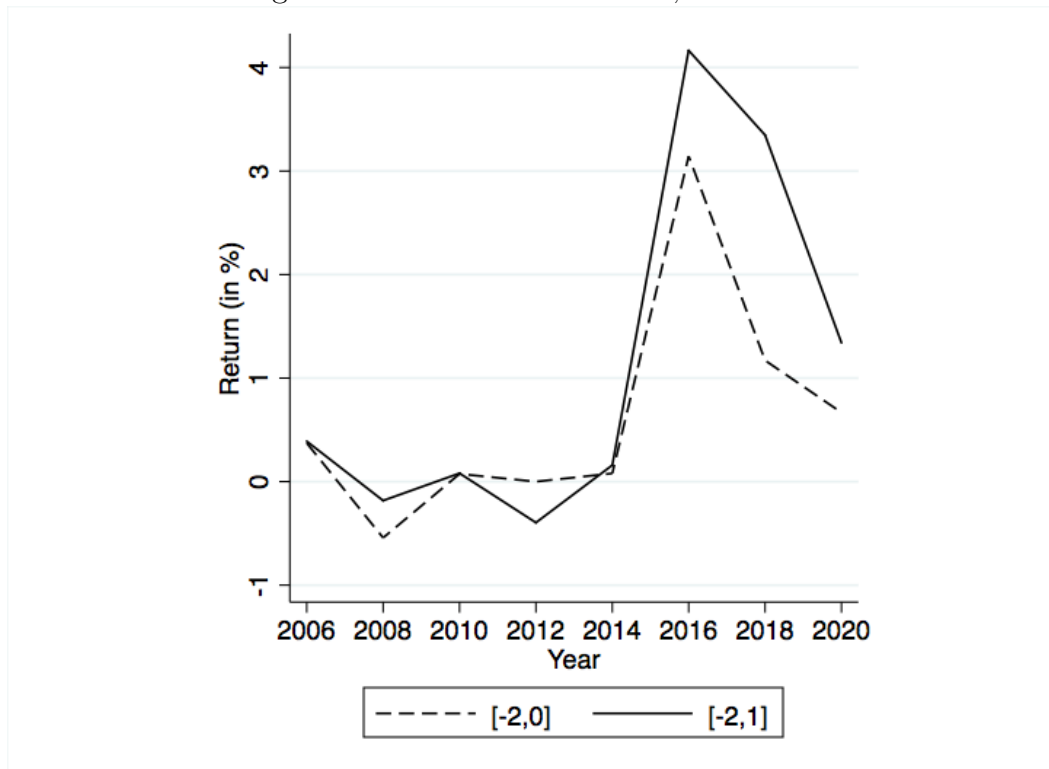
The difference between the returns to the VSTG [-2,1] strategy before and after the 2016 U.S. presidential election are even more pronounced. It is thus possible to compute difference-in-differences (DD) estimates of the post-electoral effect on VSTG returns. Before 2016, both strategies deliver similar returns (the average difference between the [-2,1] and [-2,0] strategies is 0.01% with a t-statistic of 0.11). In contrast, after the 2014 election, the average difference is 1.29% (with a t-statistic of 2.84) in favor of the [-2,1] strategy. These findings indicate that since 2016, investors have not only been concerned about electoral

uncertainty (an unforeseen outcome), but also about the realization of extreme negative events (an undesirable outcome).

3 Election Forecasts and Option Prices

The analysis of long variance swaps' returns as well as short strangles' earnings yield three important results. First, selling protection against election risk has become increasingly profitable in recent years. Second, the source of those profits can be traced not only to electoral uncertainty, but also to investors' fears of large post-electoral price changes. Third, the peak in the returns associated with *electoral* short strangles occurred in 2016, suggesting that the option market's overestimation of election risk coincided with the arrival of Donald Trump on the political scene. In this section, I examine the relationship between S&P option prices and electoral forecasts to account for the rise in risk premiums in the last two U.S. presidential elections. Implied volatility can be interpreted as the market's expectation of the average return volatility over the life of an option contract. Consequently, semi-strong form efficiency requires that market participants correctly estimate how an anticipated news release will affect the valuation of asset prices. In the context of a presidential election, option prices should thus reflect all publicly available information regarding each candidate's chance of winning. Otherwise, a discrepancy between the option market and public opinion polls would indicate that electoral risk pricing is not informationally efficient.

3.1 The Trump Factor

As in Gemmill (1992), I rely on the simple one-step binomial pricing framework introduced by Cox, Ross and Rubinstein (1979) to analyze if S&P option prices were consistent with electoral forecasts in the last two U. S. presidential elections (see Supplementary Online

Appendix A for more details). In the case of 2016, according to Wolfers and Zitzewitz (2018), markets expected the S&P 500 to be worth around 11% less under President Trump than Clinton when U.S. markets closed on November 8th, 2016 (election day). At the same time, public opinion polls suggested only a 28.6% chance that Trump would win. Were option prices consistent with the electoral forecasts? To answer this question, I calculate the probability of a Trump victory derived from option prices and compare them with Trump's winning probabilities according to public opinion polls. I place my focus in the closing month of the campaign; namely, the period between October 10th, 2016 and November 8th, 2016. I rely on the *Fivethirtyeight* election forecasts to obtain daily predictions of Trump's winning probabilities based on opinion-poll data. [13] Next, I estimate the daily values of the probability of a Trump victory derived from option prices using equation (A2) in Supplementary Online Appendix A. I rely on the VIX index to capture the market's expectation of S&P 500 returns' volatility. The index is reported for a 30-day maturity, so time to expiration (in years) is set to $\frac{30}{365} = 0.082$. Finally, as a proxy for the risk-free interest rate, I use the 1-Month U.S. Treasury par yields.[14]

The left panel of Figure 4 shows the probabilities of a Trump victory estimated from public opinion polls (dashed line) and from S&P 500 options (solid line) for the period between October 10th, 2016 and November 8th, 2016. The findings indicate that, in the closing days of the campaign option prices were consistent with the electoral forecasts. Indeed, for the last three observations (Nov. 4-Nov. 8), the options and polls probabilities are almost identical. Moreover, as noted above, market professionals were expecting a 11% decline in the S&P 500 if Trump won the election. The estimated values of the up and down move multipliers on election day (not shown), are 1.055, and 0.948, respectively. These figures imply that markets expected the S&P 500 to be worth roughly 10.7% less under President Trump than

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[13]https://projects.fivethirtyeight.com/2016-election-forecast/
[14]https://www.treasury.gov/resource-center/data-chart-center/interest-rates/

Clinton, which is very similar the expected fall estimated by Wolfers and Zitzewitz (2018). The behavior of options prices, however, was inconsistent with the information in opinion polls throughout most of the final month of the campaign. Before November 4th, 2016, option prices overestimated the probability of a Trump victory by an average of approximately 11 percentage points (28.7% compared to the 17.8% winning chance predicted by the polls). These results indicate that, overly fearful of a Trump victory, market participants were willing to consistently pay higher premiums to hedge against such an outcome.

Figure 4: Election Forecasts and Option Prices
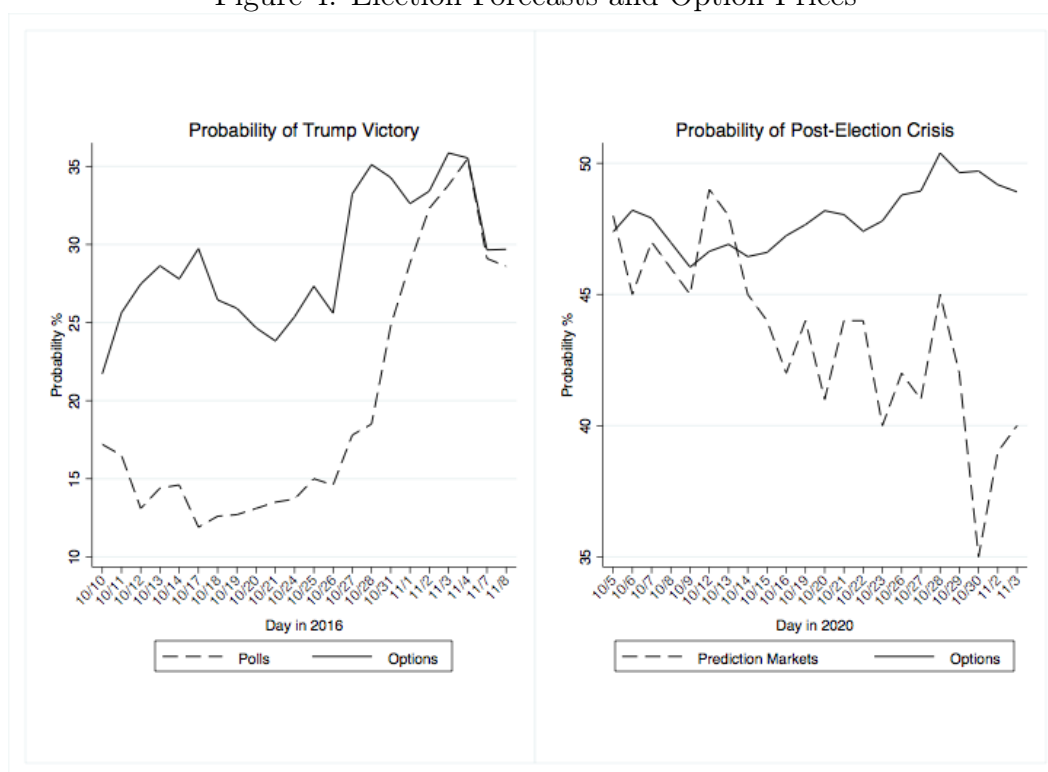
Turning to the 2020 U.S. presidential election, markets did not seem to care too strongly whether the victorious candidate would be Democratic or Republican. Instead, as the *Economist* noted, investors appeared to be especially keen on downside protection to hedge against the prospect of a period without a clear winner, as well as the potential for outright post-election chaos. In particular, markets were especially spooked by President Trump's

reluctance to say that he would accept the election result.[15] Once again, I examine the closing month of the campaign. In this case, I focus on the period between October 5th, 2020 and November 3rd, 2020. Whereas no forecasts based on public opinion polls on the issue exist, it is possible to use data from prediction markets to assess the probability that Trump would refuse to vacate the Oval Office should he lose the election. For example, *PredictIt*, an online prediction market, offered traders to sell shares on the event "Will Trump or Biden personally concede defeat within two weeks of Election Day?" I use these data to estimate the probability that Trump would refuse to accept the election result.[16] Next, I estimate the probability of a post-election crisis derived from option prices using the same inputs as before (i.e. the VIX index, and U.S. Treasury par yields).

The right panel of Figure 4 shows the probabilities that Trump would refuse to accept the election outcome estimated from prediction markets (dashed line) and from S&P 500 options (solid line) for the period between October 5th, 2016 and November 3rd, 2020. Their contrast is remarkable. In period's initial four days (Oct. 5-Oct. 8), there was some similarity between them. But, thereafter prediction markets signalled a falling probability that Trump would refuse to concede defeat, whereas option prices signalled a rising probability of a post-electoral crisis, reaching 50% on October 28th, 2020.[17] The estimated values of the up and down move multipliers on that date (not shown), are 1.122, and 0.891, respectively. These figures imply that markets expected the S&P 500 to fall by 23.1% if Trump refused to accept the election result.

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[15]https://www.economist.com/finance-and-economics/2020/10/10/how-investors-are-hedging-against-possible-election-chaos-in-america. See also: https://www.reuters.com/article/usa-election-markets/with-biden-bets-and-trump-hedges-investors-prepare-for-u-s-election-day-idUSKBN27I0NZ

[16]Daily closing prices for the period between October 5th, 2020 and November 3rd, 2020 were obtained from PredictIt, https://www.predictit.org/markets/detail/6906/Will-Trump-or-Biden-personally-concede-defeat-within-two-weeks-of-Election-Day. Data on election day (November 3rd, 2020) come from Smarkets, https://smarkets.com/event/41808439/politics/us/us-presidential-election-2020/will-trump-concede?lang=en-US

[17]In addition to president Trump, the incumbent vice-president, Mike Pence also seemed reluctant to concede defeat. In the October 8th, 2020 vice presidential debate, he provided evasive answer to a question posed by the moderator about a peaceful transition of power.

To further quantify the abnormal expensiveness of the S&P options around the 2020 U.S. presidential elections, consider the following position. Suppose that on October 7th, 2020, a market maker bought 100 plain vanilla, at-the-money calls on the S&P 500 index expiring three days after the election (Friday November 6th, 2020). According to the CBOE data, the premium for one call was 102.7 dollars. Assuming that there were no additional fees or commissions, the market maker should have borrowed 10,270 dollars to buy the call options. Suppose also that the marker maker immediately hedged the long position by short selling an appropriate number of units of the underlying index. At expiration, the position would have produced a net loss of 1,533 dollars, or approximately 15%. Note that, over the 30-day period, realized daily volatility (1.23%) was lower than the level of implied sold (1.38%). Hence, the higher prices of option prices, fueled by investors' fears of a constitutional crisis, made the hypothetical riskless hedge position unprofitable.

Conclusions

A number of scholars have examined the impact of electoral outcomes on equity market valuations. Most of this work, however, focuses on the effect of electoral outcomes on realized, or *post-electoral*, changes in asset prices. This study shows that option prices can be used to investigate investors' ex-ante assessments of election risk exposure. Based on changes in option-implied volatility around national elections in the United States between 1986 and 2020, my findings indicate that hedging against election risk has become increasingly expensive over time. The evidence also indicates that the rise in option prices allowed option traders to profit from investors' fears of large post-electoral price movements.

The electoral risk premiums uncovered here are not only statistically significant, but they are also fairly large in economic magnitude. For example, selling 9-day S&P 500 variance swap on election day in 2020 with a vega notional of USD 100,000 would have turned a

profit of approximately USD 1,637,444. In the case of the delta-hedged position opened on October 7th, 2020 discussed above, the premium for one call given by the "incorrect" volatility of 26.34% was USD 102.7, compared to a price of USD 91.7 derived from the "correct" volatility of 23.5%. The cost of a standard contract is usually 100 times the quoted price; so in this case, the loss would have been USD 1,100 per contract.

These findings are particularly noteworthy because they uncover the effects of political risk on asset prices as reflected by the option market. In contrast to many securities, option prices are closely tied down by arbitrage considerations. In addition, whereas trading in stocks and/or bonds has become increasingly common among retail investors, most of the option trading strategies examined in this study require a significant degree of financial experience, as well as considerable funding in terms of margins and collateral. Given these high stakes, one would not expect election risk to be consistently overestimated. Nonetheless, as the findings in this study show, the greater sensitivity of asset prices to electoral outcomes has led to a significant increase in how much investors have to pay to insure themselves against electoral risk. This rise in premiums, in turn, has allowed option traders to profit from selling protection against election risk.

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Supplementary Appendix to
"Political Fear and Loathing on Wall Street"

Appendix is for online publication only.

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Appendix Contents

1

A Election Risk Pricing

This appendix discuses how *election risk* can be measured using option prices. The main challenge is that any pricing approach must be based on measuring the volatility of future cash flows associated with the election. This volatility, however, is necessarily linked to randomness and with some probability distribution. So, how can we obtain a reasonable set of real-world probabilities? Modern finance has found an ingenious and practical way of dealing with this question. Following a *Martingale approach*, the assets can be priced in an *artificial* risk-neutral environment where the election risk premium is indirectly taken into account. The solution requires that the relevant probability distribution be a *market-determined probability*, rather than a *real-world probability*. Consider a tradable instrument that has: (a) an observable price; and (b) a value that depends on the distribution of an underlying asset at a given time in the future, t. For example, let's say that there is a contract paying USD 1 if an event A occurs, and 0 otherwise. The *risk neutral probability* of event A : $P_{RN}(A)$ is denoted as

$$\frac{Price\ of\ a\ contract\ paying\ USD\ 1\ if\ A\ occurs}{Price\ of\ a\ contract\ paying\ USD\ 1\ no\ matter\ what}$$

Assuming no arbitrage, $P_{RN}(A)$ satisfies the axioms of probability (its values are strictly positive and they add up to one). If the risk-free interest rate is constant and equal to r, then the price of a contract that pays one dollar at time t if A occurs should be $P_{RN}(A)e^{-rt}$ where $P_{RN}(A)$ denotes expectation with respect to the risk neutral probability. More generally, in the absence of arbitrage, the price of a tradable instrument that pays X at time t should be $E_{RN}(X)e^{-rt}$. In addition, the so-called fundamental theorem of asset pricing states that (assuming no arbitrage) interest-discounted asset prices are martingales with respect to risk neutral probability. Therefore, if a security will be worth X at time t, then its price today should be $E_{RN}(X)e^{-rt}$, where E_{RN} denotes the expectation with respect to the risk neutral probability.[1]

As this simple example shows, the market's forecast of a likely movement in a security's price following an election can be derived from option prices. Let W be a Brownian motion on the probability space $(\Omega, \mathcal{F}, \mathbb{P})$. The firm's stock price S is assumed to satisfy the stochastic

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[1]The absence of arbitrage is crucial for the existence of a risk-neutral measure. If A and B are disjoint, then $P_{RN}(A \cup B) = P(A) + P(B)$; otherwise, one could: (1) sell (buy) contracts paying 1 if A occurs and 1 if B occurs; (2) buy (sell) a contract paying 1 if $A \cup B$ occurs; and (3) pocket the difference.

differential equation (SDE)

$$\frac{dS}{S} = \sigma dW + \mu \, dt, \tag{A1}$$

where μ and σ are constants called, respectively, the *drift* and *volatility* of the stock.

Equation A1 may be written as:

$$dS = \sigma S dW + \mu S dt, \tag{A2}$$

with solution

$$S_t = S_0 \, exp \, \left[\sigma W_t + \left(\mu - \frac{\sigma^2}{2} \right) t \right]. \tag{A3}$$

Taking the logarithm of (3), we get

$$ln \, S_t = ln \, S_0 + \sigma W_t + \left(\mu - \frac{\sigma^2}{2} \right) t \tag{A4}$$

Let T_e be the election date, and Z_e a random variable representing the the jump size of the log stock price after the outcome of the election is revealed. Suppose that Z_e is independent of W. We can now write the process as

$$\frac{dS}{S} = \sigma dW + \mu \, dt + (e^{Z_e} - 1) dN(t), \tag{A5}$$

where $N(t)$ is an indicator function that takes the value of 1 when $t \geq T_e$, and zero otherwise.

To price an option on S under this process, we need to find an equivalent martingale measure and set the option price to the discounted expectation of its value in that measure. Consider a bond B_t that is continuously compounding at the risk-free rate r. The value of this riskless bond is thus e^{rt} at time t.

The expected change of S in a small time interval will be

$$\mu S \Delta t + \mathbb{E}(e^{Z_e} - 1) S \Delta t.$$

For the ratio $\frac{S}{e^{rt}}$ to be a martingale, we need S to grow at the risk-free rate; namely, we need the expected change to be $r S \Delta t$, which implies that

$$\mu + \mathbb{E}(e^{Z_e} - 1) = r. \tag{A6}$$

Therefore, the arbitrage-free price for an European option, O, expiring at time T should be

$$e^{-rt}\mathbb{E}(O(S_T)),$$

with S_T evolving according to (5) with drift given by (6).

The option price can thus be expressed in terms of the risk-neutral probability measure $\mathbb{Q}$ rather than the original probability measure $\mathbb{P}$. We can do this change of measure by using the Girsanov transformation for changing the drift of a Brownian motion (Junghenn 2012: 158-60). Let Z_e be a strictly positive random variable on $(\Omega, \mathcal{F})$ with $\mathbb{E}\{e^{Z_e}\} = 1$. If Ω is finite, the equation

$$\mathbb{Q}(A) = \mathbb{E}(\mathbb{I}_A Z), \quad A \in \mathcal{F} \tag{A7}$$

defines a probability measure $\mathbb{Q}$ on $(\Omega, \mathcal{F})$ such that $\mathbb{Q}(\omega) > 0$ iff $\mathbb{P} > 0$, and $\mathbb{Q}$ is equivalent to $\mathbb{P}$.

As in Leung and Santoli (2014), consider an extension of the Black-Scholes model with a single price jump occurring immediately after the election. Suppose that Z_e is normally distributed, then $\mathbb{E}\{e^{Z_e}\} = 1$, implying that $Z_e \sim N\left(-\frac{\sigma_e^2}{2}, \sigma_e^2\right)$, and that the election price *jump* can be parametrized by σ_e. For $T \geq T_e$, then

$$log\, \frac{S_T}{S_t} \sim N\left(\left(r - \frac{\sigma^2}{2} - \frac{\sigma_e^2}{2(T-t)}\right)(T-t), \sigma^2(T-t) + \sigma_e^2\right), \tag{A8}$$

and the price of a European call with strike K and maturity T is given by

$$C(t, S_t) = C_{BS}\left(T - t, S_t; \sqrt{\sigma^2 + \frac{\sigma_e^2}{T-t}}, K, r\right), 0 \leq t < T_e \tag{A9}$$

where $C_{BS}(\tau, S; \sigma, K, r)$ represents the usual Black-Scholes formula with time to maturity τ and spot price S. Given this price formula, the implied volatility (IV) can be expressed as the deterministic function:

$$I(t; K, t) = \begin{cases} \sqrt{\sigma^2 + \frac{\sigma_e^2}{T-t}} & \text{if } 0 \leq t < T_e \\ \sigma & \text{if } T_e \leq t < T, \end{cases} \tag{A10}$$

where σ is the diffusive volatility.

B One-Step Binomial Pricing Framework

Let O_t be a European option on an underlying asset with a current price S_t. Denote the option's strike by K, its expiry by T, and the election day as T_e, where $t < T_e < T$. An option bought ahead of the date when the identity of the winning candidate is revealed (at time $t \leq T_e$) will give someone the right to trade the underlying at a strike price of K after the election takes place. To keep things simple, I assume that the underlying asset will pay no cash dividends during the life of the option. I also ignore transaction costs, margin requirements, and taxes.

Suppose that at expiration, the spot price of the underlying asset can only have two possible values. With probability q, it can increase, and become $S_T^u = uS_t$, where $u > 1$; and with probability $(1-q)$, it can decrease, and become $S_T^d = dS_t$, where $d < 1$. Therefore, for $S_T = \{S_T^u, S_T^d\}$, the option's value at expiration will be $C_T = max(0, S_T - K)$ in the case of a call, and $P_T = max(0, K - S_T)$ in the case of a put. To avoid riskless arbitrage opportunities, O_T should be equal to the value of O_t invested for the time interval $\Delta = T - t$ at the risk-free interest rate, $O_T = O_t e^{r\Delta}$, or equally, $O_t = O_T e^{-r\Delta}$.

As Cox, Ross and Rubinstein (1979) show, the value of the option O_t can be calculated as:

$$O_t = e^{-r\Delta}[pO^u + (1-p)O^d], \tag{B1}$$

where O^u is the value of the option at expiration if the price of the underlying goes to uS_t, O^d is the value of the option at expiration if the price of the underlying goes to dS_t, and:

$$p = \frac{e^{r\Delta} - d}{u - d}. \tag{B2}$$

There are many plausible available choices with regard to the parameters u and d. For instance, the price of the underlying asset could either increase by 1.8% or decrease by 1.5%. Following Cox, Ross, and Rubinstein (1979), I adopt the parametrization, $u = e^{\sigma\sqrt{\Delta}}$, where σ is the volatility of the underlying asset. Assuming that the product of the up move multiplier and the down move multiplier is 1, then $d = e^{-\sigma\sqrt{\Delta}}$.

Equation (A2) can help us elucidate the relationship between option prices and electoral forecasts. First, notice that, as long as the interest rate is positive, then $d < e^{r\Delta} < u$. Therefore, p has the properties of a probability: it will always be greater than zero and less than one. Second, as Cox, Ross, and Rubinstein (1979) note, p is the value that would justify the current price of the underlying asset, S_t, in a risk-neutral world. In the context of a national election examined here, we can interpret p as the probability that the spot price will increase to S_T^u at time $T_e < T$.

So, consider a presidential election between two candidates, L and R. Assume that on day $t < T_e$ during the campaign, the option O_t expires in one month, the riskless interest rate is 2.5%, and the volatility of S_t is 20%. According to those inputs, and using equation (7), $p = 0.68$. Suppose the market expects the underlying asset to increase (decrease) in value if R wins (loses). To the extent that asset prices are sensitive to electoral outcomes, then R's probability of winning, as predicted by public opinion polls should be roughly 68%. Otherwise, the behavior of options prices would be inconsistent with the information in public opinion polls.