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High policy uncertainty and low implied market volatility: An academic puzzle?☆

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ABSTRACT

Motivated by the extremely low level of the CBOE VIX accompanied by the high level of U.S. economic policy uncertainty in the period of late 2016 to the end of 2017, we examine the factors affecting the relationship between market volatility and economic policy uncertainty in the United States and the United Kingdom. Our analysis shows that low-quality political signals, higher opinion divergence among investors, and exceptional equity market performance consistently weaken the positive relationship between implied market volatility and policy uncertainty. Our findings help to explain the divergence between the market volatility index and economic policy uncertainty post the 2016 U.S. presidential election and the UK Brexit referendum.

1. Introduction

Empirical studies have documented a significant positive correlation between stock market volatility and economic policy uncertainty (Sum and Fanta, 2012; Liu and Zhang, 2015; Li et al., 2016; Goodell et al., 2020). Periods characterized by high economic policy uncertainty often experience significantly higher risk premia, and more volatile stock returns (Pástor and Veronesi, 2012).

The Chicago Board Options Exchange's (CBOE) volatility index (VIX) has been widely used as a proxy for the "fear gauge" of market participants.[1] As the VIX is derived from the prices of S&P 500 index options, which tend to be more expensive in a volatile economic policy environment (Kelly et al., 2016), it is expected that a higher degree of economic policy uncertainty is associated with a higher VIX level. In the period since the 2016 U.S. presidential election, the VIX has hovered at extremely low levels, while both economic policy uncertainty (EPU), proxied by the widely used Baker-Bloom-Davis (BBD) news-based index, and the S&P 500 index have reached high levels.[2] Interestingly, a similar puzzling divergence (between the

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[1] Launched in 1993 by the CBOE, the VIX captures investors' expectations of stock market volatility over the next 30-day period. The level of the VIX is important for market participants who consider it as a barometer of the equity market volatility (Whaley, 2000; Whaley, 2009; Shaikh and Padhi, 2015).

[2] The Baker-Bloom-Davis (BBD) news-based index was often employed as proxies for the extent of economic policy uncertainty and have been employed in a number of studies (e.g., Brogaard and Detzel, 2015; Loh and Stulz, 2018). The constructions of the BBD news-based index will be discussed in the data section.

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UK implied market volatility index, VFTSE, and the FTSE 100 index) was observed in the UK after the 2015 general election and the subsequent referendum on European Union (EU) membership. This puzzling phenomenon is unlikely to be the outcome of a short-lived anomaly. The observed divergences suggest that there are factors affecting the relationship between market volatility and economic policy uncertainty.

In this study, we examine the relationship between the low levels of the implied market volatility index and the high degree of policy uncertainty observed in the U.S. and UK markets. We investigate three potential explanatory factors, namely, the quality of political signals, investors' opinion divergence, and equity market performance, over the period of January 2000 to March 2020 for the United States and the period from January 2001 to May 2020 for the UK market. We are not aware of any studies which *empirically* examine the contributions of these three factors to this puzzling phenomenon in the two leading developed markets.

Our analysis on the quality of political signals and equity market performance are guided by the theoretical model of Pástor and Veronesi (2013).[3] They show that in spite of the high economic policy uncertainty, noisy political signals are likely to result in rare updates in investors' beliefs, which leads to lower political risk premia and market volatility.[4] We develop a new index as our primary measure of the quality of political signals using the methodology proposed by Baker et al. (2016).[5] Specifically, for a given period, our index reflects the frequency of articles in leading nationwide newspapers that contain the terms related to policy, signals, and quality. In the period post the election of Donald J. Trump as the U.S. president and the Brexit referendum in the UK, our index increased substantially, indicating a deterioration in the quality of political signals.

Pástor and Veronesi (2013) also state that in a stronger economy, the government is less likely to adopt a new policy; therefore, political news regarding which new government policy is likely to be adopted has a smaller impact on stock prices. Consequently, the political risk premia and market volatility are lower in strong economic conditions. In light of this implication, we empirically test if equity market performance affects the link between market volatility and economic policy uncertainty. The examination of opinion divergence among investors as a factor impacting the relationship between market volatility and economic policy uncertainty is motivated by Dumas, Kurshev, and Uppal's (2009) study. Their theoretical model suggests that the fluctuation of investors' opinions contributes to overtrading in the stock market and consequently leads to a higher volatility, whereas noisy signals create divergences in investors' opinions.

Our main findings show that the commonly accepted positive relationship between market volatility and economic policy uncertainty varies with different levels of the quality of political signals, opinion divergence among investors, and equity market performance. Specifically, our analysis shows that during times characterized by quasi-truth, alternative facts, and fake news, one can expect a weaker link between the fear gauge and economic policy uncertainty. Exceptional performance of the equity market and high opinion divergence have similar impacts on the link. Moreover, we find that the quality of political signals is the dominant factor out of the three factors considered in this study. During times when the quality of political signals is low (one standard deviation away from its mean), the link between the implied market volatility and economic policy uncertainty can be easily two times weaker. Our empirical results support the implications of the theoretical models proposed by Pástor and Veronesi (2013). The results are robust to the selection of proxies for the three examined factors.

The remainder of this paper is structured as follows. Section 2 reviews the relevant literature and formulates the research questions. Section 3 describes the data and methodology employed. Section 4 discusses the results, and Section 5 concludes with the main findings.

2. Literature and research questions

The observed low level of the market volatility indices, albeit with a high degree of economic policy uncertainty, has drawn increasing attention from practitioners and researchers.[6] In this section, we will present a brief literature review and formulate our research questions.

2.1. Quality of economic/political signals

The studies conducted by Pástor and Veronesi (2012, 2013) develop a theoretical model and explain the relationships between stock price, market volatility, and economic policy uncertainty. They show that political shocks reflect the continuous flow of political news and lead investors to update their beliefs about the likelihood of the different potential future policy choices. In their model, the effect of political shocks on stock prices and market volatility is greater when political signals are more precise and when there is more policy uncertainty. In other words, the model implies that market volatility is an increasing function of the product of political uncertainty and the quality of political signals (Pástor and Veronesi, 2017). The authors argue that when political signals are precise on governments' prospective policy actions, market volatility and economic policy uncertainty are expected to move together. However, when faced with poor political signals, investors do not update their beliefs often and hesitate to react in the financial markets. In this situation,

[3] When political signals (such as news) are precise and informative, the quality is high. In contrast, when political signals are imprecise, for instance, with many reversals and contradictions, the political news is less informative and noisier, and thus the quality is low.

[4] Pástor and Veronesi (2013) discuss the impact of the precision of political signs in the theoretical model (section 4.1.2 Political shocks).

[5] Our data with monthly updates is available at http://www.qualityofpoliticalsignals.com.

[6] See, for example, Banerji (2017), Ciolli (2017), Figlewski (2017), Moyo (2017), Pástor and Veronesi (2017), and Weber (2018).

it is not unusual to observe low market volatility, albeit with a high level of economic policy uncertainty. This scenario is consistent with the puzzling phenomenon observed in the U.S. post the 2016 presidential election and in the UK market since the 2015 Brexit referendum.

The prevalence of fake news and imprecise news make it difficult for investors to interpret political signals, to dissect reversals and contradictions, and to evaluate their potential impact on investment risks (Pástor and Veronesi, 2017). As a result, investors tend to wait and see, which leads to lower market volatility. Considering the positive correlation between stock market volatility and economic policy uncertainty documented by previous studies (e.g., Sum and Fanta, 2012; Liu and Zhang, 2015; Li et al., 2016; Goodell et al., 2020), and in light of the theoretical model proposed by Pástor and Veronesi (2013), along with recent political developments in the United States and the UK, we would like to test if the relationship between policy uncertainty and market volatility is affected by the quality of political signals.

2.2. Investors' opinion divergence

Several studies present evidence that investors tend to be overconfident and often overreact to political signals (De Bondt and Thaler, 1985; Darrat et al., 2007). Dumas et al. (2009) formulate a theoretical model to analyze the effects of the difference of opinions on stock price volatility. The model implies that the larger the fluctuations in the sentiment of overconfident investors relative to investors with the proper beliefs, the higher the market volatility. A number of studies on heterogeneous opinions also present strong evidence that divergence in investors' opinions significantly raises the level of market volatility.[7] Considering the large flow of information released in the U.S. and UK markets, it tends to be difficult for investors to interpret all political signals. Thus, the degree of opinion divergence among investors could be higher than ever observed. Consequently, the market volatility would be expected to be high by investors, according to the existing literature (Scheinkman and Xiong, 2003; Buraschi and Jiltsov, 2006; Andrei et al., 2015). In light of this discussion, we would like to test if opinion divergence among investors affects the link between policy uncertainty and market volatility.

2.3. Exceptional equity market performance

The exceptional performance of the U.S. and UK equity markets in the 2016–2017 period encourages us to ask whether a bull spell has an impact on the relationship between the fear gauge and economic policy uncertainty.[8] The theoretical model developed by Pástor and Veronesi (2013) predicts that the positive correlation between stock volatilities and political uncertainty gets stronger when economic conditions are weaker. This is because when the economy is weak, the current policy is more likely to be replaced by the government, and so the impact of which new policy the government might adopt in the future – political shocks – is greater.

Despite the fact that stock market conditions are one of the indicators of economic conditions, the relationship between equity market performance and economic growth is rather complex.[9] Therefore, it is difficult to determine *a priori* the effect of the equity market on the scrutinized correlation. Additionally, persistent good performance of the stock market could be associated with potential representativeness bias. The behavioral finance literature suggests that investors are prone to perceive an investment as good or bad based on its most recent performance (De Bondt and Thaler, 1985; Benartzi and Thaler, 1995; Barberis et al., 1998), and expect that the recent trends in prices will persist (De Bondt, 1993; Shleifer, 2000; Kim and Nofsinger, 2008). As the continuous bull market unfolded in 2017, investors affected by representativeness bias were more likely to underestimate potential investment risks and lowered their assessment of market volatility. Considering the reasons discussed above for why the performance of the equity market may matter, we investigate if persistent good performance of the stock market affects the relationship between policy uncertainty and the fear gauge, such as the VIX or VFTSE.

3. Variables

This section discusses our measures of the quality of political signals, investors' opinion divergence, and exceptional performance of equity markets. We start with a brief, but important presentation of the proxy for economic policy uncertainty.

3.1. Economic policy uncertainty

We employ the BBD news-based policy uncertainty index as the proxy for economic policy uncertainty. The gauge was proposed and tested by Baker et al. (2016). The BBD EPU for the United States quantifies the coverage of policy-related economic uncertainty in ten popular newspapers, namely *USA Today, Miami Herald, Chicago Tribune, The Washington Post, Los Angeles Times, The Boston Globe, San Francisco Chronicle, The Dallas Morning News, Houston Chronicle*, and *The Wall Street Journal*. To construct the BBD EPU, the terms related to economic and policy uncertainty were searched in each newspaper and each month starting from January 1985 to present. To meet the criteria for being counted, each policy uncertainty article had to include the terms in all three categories pertaining

[7] See Scheinkman and Xiong (2003); Buraschi and Jiltsov (2006); Næs and Skjeltorp (2006); Carlin et al. (2014); Chan et al. (2004); Andrei et al. (2015); Siganos et al. (2017).

[8] Our analysis reveals that, in the United States, the end of December 2017 marked the 14th consecutive month over which the S&P 500 Total Return Index achieved positive returns accompanied by low levels of the VIX and realized market volatility. Since 1871, such persistent positive performance has only occurred six times, with each bullish streak lasting at least for 12 consecutive months. In the UK, over the 2016–2017 period, the FTSE 100 Total Return Index increased by 33%, showing positive returns for 17 out of the previous 24 months.

[9] See, for example, Fama (1990), Ferson and Harvey (1993), Cheung and Ng (1998), Mauro (2003), Ritter (2005), Lyócsa (2014), Tiwari, Albulescu and Gupta (2016).

to uncertainty, economy, and policy.[10] The monthly count of policy uncertainty articles in each newspaper was divided by the respective monthly total number of articles. The resulting monthly series for each newspaper was then normalized to have a unit standard deviation before being summed across newspapers to obtain a monthly multi-paper index. This index was then re-normalized to an average value of 100.[11]

The BBD EPU index for the UK quantifies the coverage of policy-related economic uncertainty. It was constructed based on searches of articles with the terms in all three categories pertaining to uncertainty, economy, and policy and then quantifies the coverage of policy-related economic uncertainty in ten leading UK newspapers: *Financial Times, The Times, The Telegraph, Daily Mail, Daily Express, The Guardian, Mirror, The Northern Echo, Evening Standard*, and *The Sun*.[12]

Panels A and B of Fig. 1 depict the time-varying relationship between the volatility index and the EPU index for the United States and the UK, respectively. In both cases, we observe a substantial divergence between the volatility index and EPU index from 2016 onwards. Specifically, the VIX index has hovered at historically low levels, whereas the EPU reached its peaks after the U.S. presidential election had concluded. For the UK, the divergence between the VFTSE and EPU accelerated and widened after Prime Minister David Cameron announced the date of the Brexit referendum.

The average level of the VIX in 2017 corresponds to the 3rd percentile over the period 2000–2016, while the average of U.S. EPU in 2017 is equivalent to the 74th percentile of its values measured over 2000–2016.[13] The mean value of the S&P 500 index in 2017 was the highest of its values over the period 2000–2017. A similar feature can be noticed in Panel B of Table C.1: For the UK, the average level of the VFTSE index in 2017 corresponds to the 4th percentile over the period 2001–2016, while the average of the UK EPU in 2017 is equivalent to the 94th percentile of its values measured over 2001–2016.

3.2. The quality of political signals

In this section we present three different measures for the quality of political signals for the U.S. and UK markets. Moreover, we discuss data availability as well as the advantage and potential weakness of each proxy.

3.2.1. Qindex as measure of signal quality

Our primary measure of the quality of political signals is an index, *Qindex*. We created this index based on the approach used by Baker et al. (2016) to create the EPU index. Instead of the EPU index, we constructed an index measuring the quality of political signals. Specifically, we analyzed the set of ten leading newspapers based on their circulation:[14] *USA Today, The Washington Post, The Boston Globe, The New York Times, The Wall Street Journal, Tampa Bay Times, New York Post, New York Daily News, Star Tribune*, and *The Atlanta Journal Constitution*. Using the Factiva database, we scanned the digital archives of each U.S. newspaper between January 2000 and March 2020 to obtain a monthly count of articles containing the following terms belonging to three categories: quality (e.g., “false”, “misleading”, or “ambiguous”), signal (e.g., “signal”, “declarations”, or “claim”), and policy (e.g., “deficit”, “legislation”, or “Federal Reserve”). In other words, to meet our criteria, an article must contain terms in all three categories pertaining to quality, signal, and policy, which are different from Baker, Bloom and Davis’s three searching categories pertaining to uncertainty, the economy, and policy. In our measure of the quality of political signals, we kept the *policy category* of Baker, Bloom, and Davis but replaced the other two with *quality and signal* terms. Consistent with the approach of Baker et al. (2016), we then scaled the raw counts by the total number of articles in the same newspaper and month to deal with the issue that the overall volume of articles varies across newspapers and time. Next, we standardized each monthly newspaper-level series to unit standard deviation from January 2000 and July 2019 and then average across the ten papers by month. Finally, we normalized the ten-paper series based on the same period.

Using the above-described method, we also constructed a UK *Qindex* variable for the period January 2001 to May 2020 by analyzing ten leading newspapers in the UK: *Financial Times, The Times, The Telegraph, Daily Mail, Daily Express, The Guardian, Mirror, The Northern Echo, Evening Standard*, and *The Sun*. The *quality* and *signal* terms remain the same as for the U.S. market, but we adjusted slightly the *policy* terms to reflect specifics of the UK political scene. Appendix A contains the whole vocabulary of terms related to the three categories together with two examples of press articles (see Fig. A.1). Moreover, Appendix A offers some of the stylized facts of the U.S. and UK *Qindices* and an analysis of their co-movements with corresponding EPU indices. Fig. 2 shows the relationship between fear gauges (i.e., CBOE VIX and VFTSE) and *Qindices* for the U.S. market and the UK market, respectively. Our *Qindices* with monthly updates are available at our website: www.qualityofpoliticalsignals.com.

3.2.2. EPU variability

In order to deal with a potential critique that our results may be driven by our selection of *Qindex* as a key measure, we consider an alternative proxy for the imprecision of political signals, namely the absolute difference between the monthly EPU index and the average of the daily EPU index within a given month (*EPUV*). *EPUV* is

[10] The terms searched in each article include uncertainty or uncertain, economic or economy, and one or more of the following terms: Congress, legislation, White House, regulation, Federal Reserve, and deficit.

[11] Monthly BBD indices have been widely applied as the proxy for economic policy uncertainly in the literature (see, for example, Klößner and Sekkel, 2014; Gulen and Ion, 2016; Liu and Zhang, 2015; Bonaime, Gulen, and Ion, 2018).

[12] According to BBD, the policy-relevant terms used in the UK EPU index are different from that of the U.S. EPU index.

[13] Table C.1 in the appendix illustrates the discussed divergence between fear gauges and EPU indices in 2017.

[14] In order to determine most important newspaper in terms of circulation in the United States, we use the following source: https://www.statista.com/statistics/184682/us-daily-newspapers-by-circulation/.

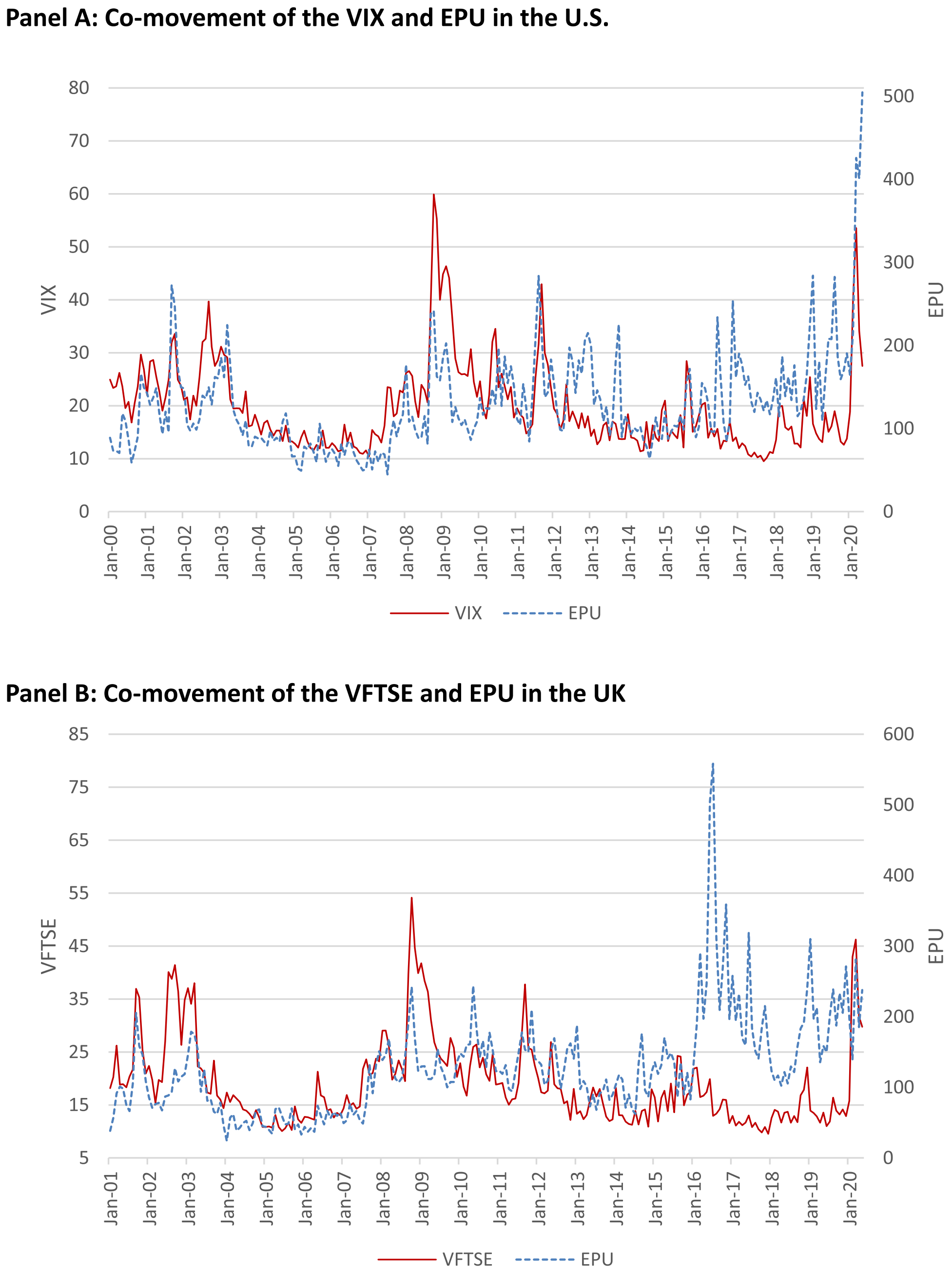

Fig. 1. Economic political uncertainty and implied volatility index.
This figure presents the co-movement between the EPU index and the implied volatility index for the U.S. and UK markets.

likely to capture the difference in the perception of economic uncertainty between local (daily EPU) and national (monthly EPU) levels.[15] We argue that such a difference tends to be caused by a) the diverse opinions between local and national reporters on economic uncertainty when the signal quality is high, or b) different interpretations of prevailing economic uncertainty as a result of low-quality signals. The first explanation (a) is less likely, as the access to information and the professionalism of journalists is comparable and may only differ at the very top of the journalist profession. Therefore, the difference between the EPUs by local and national newspapers is more likely to be driven by imprecise signals. Hence, we argue that periods with high *EPUVs* tend to be characterized by more imprecise signals. We calculate the *EPUV* proxy for the U.S. and UK markets. The advantage of *EPUV* as a proxy is that it can be estimated directly from EPU time series. The

[15] The daily EPU constructed by BBD is based on over 1000 newspapers covered by NewsBank, among which there are many local newspapers, while the monthly BBD only considers the top ten newspapers in the United States.

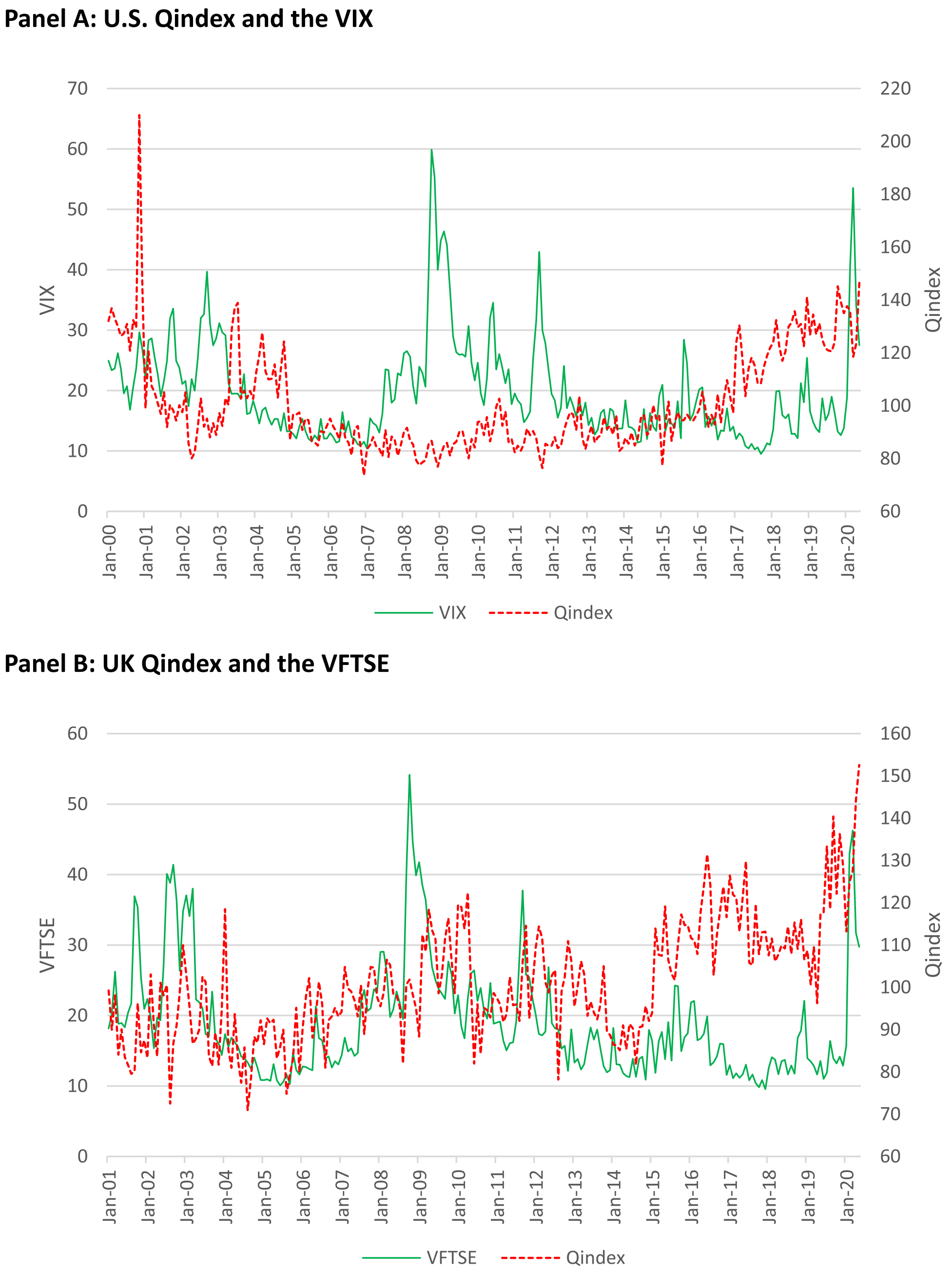

Fig. 2. Quality of political signals and implied volatility index.
This figure presents the co-movement between the *Qindex* and the implied volatility index for the U.S. and UK markets. The *Qindex* is the constructed measure of the quality of policy signals.

potential disadvantage is that the variability of the daily EPU may be impacted by factors other than the quality of signals. Thus, it may not be as representative of the quality of political signals as *Qindex*.

3.2.3. Washington post fact checker

We followed Pástor and Veronesi's (2017) suggestion and used the *Washington Post* Fact Checker data for the U.S. market. Since January 2017, *The Washington Post* has been reporting the counting data on the number of false or misleading claims made by former President Donald J. Trump. We employ the five-day moving average of the number of false or misleading claims on all topics on a daily basis (*WPFC*), and expect that the more false or misleading claims are reported, the more imprecise are the political signals. We consider the moving average of reported false or misleading claims because the effect of imprecise political signals ought to have grown over time, since people might not know how much of today's verbiage will be shown to have been false until sometime later. The advantage of the proposed measure is that *WPFC* is exogenous to both the VIX and EPU index and allows us to address potential concerns of reverse-causality.[16]

3.3. Divergence in investors' opinions

When investors' opinions disagreement is low, expectation of future market movement should be aligned among market participants. In such a case, most investors agree on the expected direction that the market will move towards. As a consequence, there will be a dominant sentiment among market participants. The dominant sentiment could be either bullish or bearish, with each percentage being much higher than the other, and will lead to a relatively high variation in the sentiment percentages. Therefore, a higher variation in sentiment percentages indicates a lower level of investors' disagreement. On the other hand, when the disagreement among market participants is high, investors are more likely to stick with their own opinions about the market's future movement and there is not much difference, particularly between the percentages of bullish and bearish investors. For instance, in the scenario when opinion divergence among market participants is extremely high, the sentiment percentages of bullish and bearish would be equally split. Therefore, a smaller variation in sentiment indicates a higher level of investors' opinion divergence (a lower opinion consensus). Investors' sentiment can be measured by surveys or activity on option markets. In this study, we consider three different measures of investors' opinion divergence.

As the first measure of opinion divergence, we employ a measure calculated using the put-call option volume ratio. This ratio has been employed in a number of studies (see Pan and Poteshman, 2006; Bandopadhyaya and Jones, 2008; Qian 2009; Burghardt, 2011; Johnson and So, 2012; Lee and Wang, 2016; Bathia and Bredin, 2018). A high put-call ratio indicates that more put options were purchased in comparison with call options. The higher demand on put options is a sign of negative market sentiment (Burghardt, 2011). We used the put-call ratio to calculate another ratio (*PC*) as follows:

$$PC = \frac{|call\ volume - put\ volume|}{call\ volume + put\ volume} = \frac{|1 - put/call\ |}{1 + put/call}, \quad (1)$$

where *put volume* is the trading volume of put options on CBOE, *call volume* is the trading volume of call options, *put/call* is the put-call option volume ratio. The *PC* ratio allows us to measure the sentiment difference between "bearish" investors who traded the put options and "bullish" investors who traded the call options. We employ the CBOE put-call volume ratio of total options traded on exchanges for the U.S. equity market.[17] A higher *PC* ratio indicates that the trading volume of put or call options is larger than the other. It suggests that most of the investors expect the market to move in a certain direction, and hence reflects a higher consensus (lower divergence) among investors' opinions.

Our second measure for investors' opinions divergence is based on the American Association Individual Investor (AAII) sentiment surveys, which have been conducted weekly since the late 1980s among individual investors. In each survey, members are asked a simple question: "Do you feel the direction of the stock market over the next six months will be up (bullish), no change (neutral), or down (bearish)?" A number of media outlets, including Barron's and Bloomberg, publish AAII survey data. Not surprisingly, the data have been used in academic studies (e.g., Brown, 1999; Verma and Soydemir, 2009; Jacobs, 2015). Consistently, we calculate our second measure of opinion divergence, namely individual sentiment deviation (*ISD*), as the variation between individual investors' sentiments:

$$ISD = \frac{|\text{Bullish} - \text{Bearish}|}{\text{Bullish} + \text{Bearish}}, \quad (2)$$

where *Bullish* is the percentage of AAII bullish individual investors and *Bearish* is the percentage of AAII bearish individual investors. Similarly, a higher *ISD* indicates that the percentage of bullish sentiment or bearish sentiment is larger than the other, suggesting that most of the investors expect the market to move in a certain direction, and hence there is a higher opinion consensus (lower divergence).

The third measure of opinion divergence is constructed by employing one of the stock market confidence indices proposed by Shiller (2000). His-indices have been examined in recent studies (e.g., Chiu et al., 2018; Malliaropulos and Migiakis, 2018; Wang and Young, 2020). In our analysis, we use the U.S. Valuation Confidence Index for institutional investors.[18] The U.S. Valuation Confidence Index is a survey-based index constructed by surveying U.S. institutional investors. They are asked about their perception of stock prices in the United States in comparison with fundamental value. Each respondent may select one of four alternatives: (1) too low, (2) too high, (3) about right, and (4) do not know. The Valuation Confidence Index is the number of respondents who choose 1 (too low) or 3 (about right) as a perce2832ntage of those who choose 1, 2, or 3. Thus, the index reports the percentage of the institutional investors who think that the current market is not too high. When the opinion divergence is high, it is expected that half of investors are likely to think the current market is too high, whereas the rest think it is not. Consequently, the U.S. Valuation Confidence Index is likely to be close to 50. On the other hand, when most investors think the market is too high (low), the value of the U.S. Valuation Confidence Index should be low (high). Hence, we calculate our third proxy, namely Robert

[16] Figure B.1 in the appendix shows the co-movement between different proxies for the quality of political signals.

[17] We also applied the put-call volume ratio of CBOE Index options. The results remain unchanged.

[18] The index value is reported monthly after July 2001, before which it was only reported in March and June in 2001. We assume the index value remained the same for every three months before July in 2001. As a robustness test, we allowed missing values for the index in those months in 2001, and our results still hold. Source: https://som.yale.edu/faculty-research-centers/centers-initiatives/international-center-for-finance/data/stock-market-confidence-indices/united-states-stock-market-confidence-indices.

Shiller's index measure (*RSI*), as following:

$$RSI = |\text{U.S. Institutional Valuation Confidence Index} - 50|. \quad (3)$$

Consistent with *PC* and *ISD*, a higher value of *RSI* indicates a higher opinion consensus (lower opinion divergence).[19]

Despite our best efforts, we found that the Lloyds Bank Investor Confidence Index and Hargreaves Lansdown Sentiment Index, two well-established investors' sentiment indices in the UK market, are not available for academic research. As a result, our attention focuses on the put-call volume ratio of the FTSE 100 index *(PC)* options as a proxy of investors' opinion divergence for the UK market. The construction of the *PC* measure is analogous to one defined for the United States. A higher *PC* for the UK indicates a higher consensus (lower divergence) among investors' opinions.

Fig. 3 shows the co-movement between our opinion divergence measures and the volatility indices in both countries. One striking observation is that the periods of high opinions consensus (low opinions divergence), as proxied by high *PC* ratio, showed low levels of implied market volatility.

3.4. Equity market performance

To test how a bullish market potentially accompanied by investors' representativeness bias affects the relationship between policy uncertainty and market volatility, we construct a variable, *CPM,* defined as the number of consecutively positive-return months of the S&P 500 Total Return Index. As a variation, we consider an alternative proxy for a bullish market calculated as the number of positive-return months of the S&P 500 Total Return Index in the last six months (*PM*).[20] Similar to the *CPM,* a high *PM* value indicates a good performance of equity in the last half of a year, which is likely to imply a greater probability that investors may exhibit a representativeness bias.

In the past academic literature, proxies of past performance, such as *CPM* and *PM*, have been used for analysis of representativeness bias in equity markets (e.g., Chan et al., 2004; Kim and Nofsinger, 2008; Tekçe et al., 2016). Moreover, the financial press often uses the number of months characterized by positive returns as a proxy of bullishness in the stock market.[21] The construction of the UK *CPM* and the UK *PM* is analogous to the U.S. ones; however, we use the FTSE 100 index instead of the S&P 500. Fig. 4 presents the relationship between *CPM* proxies and the fear gauge for the U.S. and UK equity markets, respectively. It is not surprising to find that the period characterized by a high value of *CPM* coincides with the period of low value of implied volatility.

In addition to the *CPM* and *PM* variables designed to measure persistence of positive monthly returns, we apply a tail risk measure as the third proxy for the exceptional performance of the equity market. It has been documented by previous studies that investors take into consideration the tail risk associated with extreme market downturns and require a premium for stocks with higher tail risks (e.g., Ang et al., 2006; Kelly and Jiang, 2014; van Oordt and Zhou, 2016). In particular for institutional investors, left-tail events are actively monitored and reacted to (Atilgan et al., 2020). Following the approach of Bali et al. (2009) and Atilgan et al. (2020), we use the lower tail of actual empirical distribution to calculate a non-parametric measure of expected shortfall (*ES*) of stock market indices. More precisely, for each daily observation, the *ES* is calculated as the mean of daily returns of observations which are lower than or equal to the 5th percentile of the daily returns for the market index during the past year (252 trading days). A lower value of *ES* indicates a higher tail risk and provides evidence for weaker performance of the stock market.

While the variables defined above are proper measures for stock market performance, they are also subject to caveat, as they tend be influenced by national politics (at least part of it relevant to the local equity market) and, to some extent, they may have an impact on national politics directly or indirectly. Taking into account the macro character of variables, disentangling the causality relationship between variables can be complex. However, establishing causality is not the attempt of this study, as our main focus is on the relationship between the fear gauge and economic uncertainty.

4. Data and methodology

Our study covers a period from January 2000 to March 2020 for the U.S. market and January 2001 to May 2020 for the UK market.[22] The sample for the United States includes 5100 daily observations of the VIX, S&P 500 index, and U.S. EPU index (BBD's news-based). The sample for the UK includes 4886 daily observations of the VFTSE, FTSE 100 index, and UK EPU index. The daily closing values of the S&P 500 index, VIX, VFTSE, FTSE 100 index, and daily EPU indices, the weekly values of the AAII sentiment index, and the monthly values of EPU indices are collected from Bloomberg. The newspaper archive data used to construct our *Qindices* measure are sourced from the Factiva database. The U.S. Valuation Confidence Index is obtained from the website of the International Center for Finance, Yale University. Data on the number of false/misleading claims for *WPFC* is manually collected from the website of *The Washington Post* newspaper. The descriptive statistics of the variables employed in our study are summarized in

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[19] We also tested with the U.S. Valuation Confidence Index for individual investors and other alternative measures, such as the absolute value of the sentiment index proposed by Baker and Wurgler (2006). Our results were confirmed.

[20] We also tested with an alternative measure of *PM*, calculated as the number of positive-return months of S&P500 index in last 12 months. Our results still hold.

[21] See the following articles in financial newspapers: "S&P 500 set to break record with 'perfect' calendar year" by *Bloomberg* on 15th November 2017; "The Message in the S&P 500's 12-Month Winning Streak" by *Financial Times* on 23rd December 2017.

[22] The sample period for the U.S. and UK markets differs due to the data availability needed for construction of the *Qindex* and the U.S. Valuation Confidence Index. For the U.S. market, results with measures available until May 2020 are also consistent with the above reported. These results are available upon request.

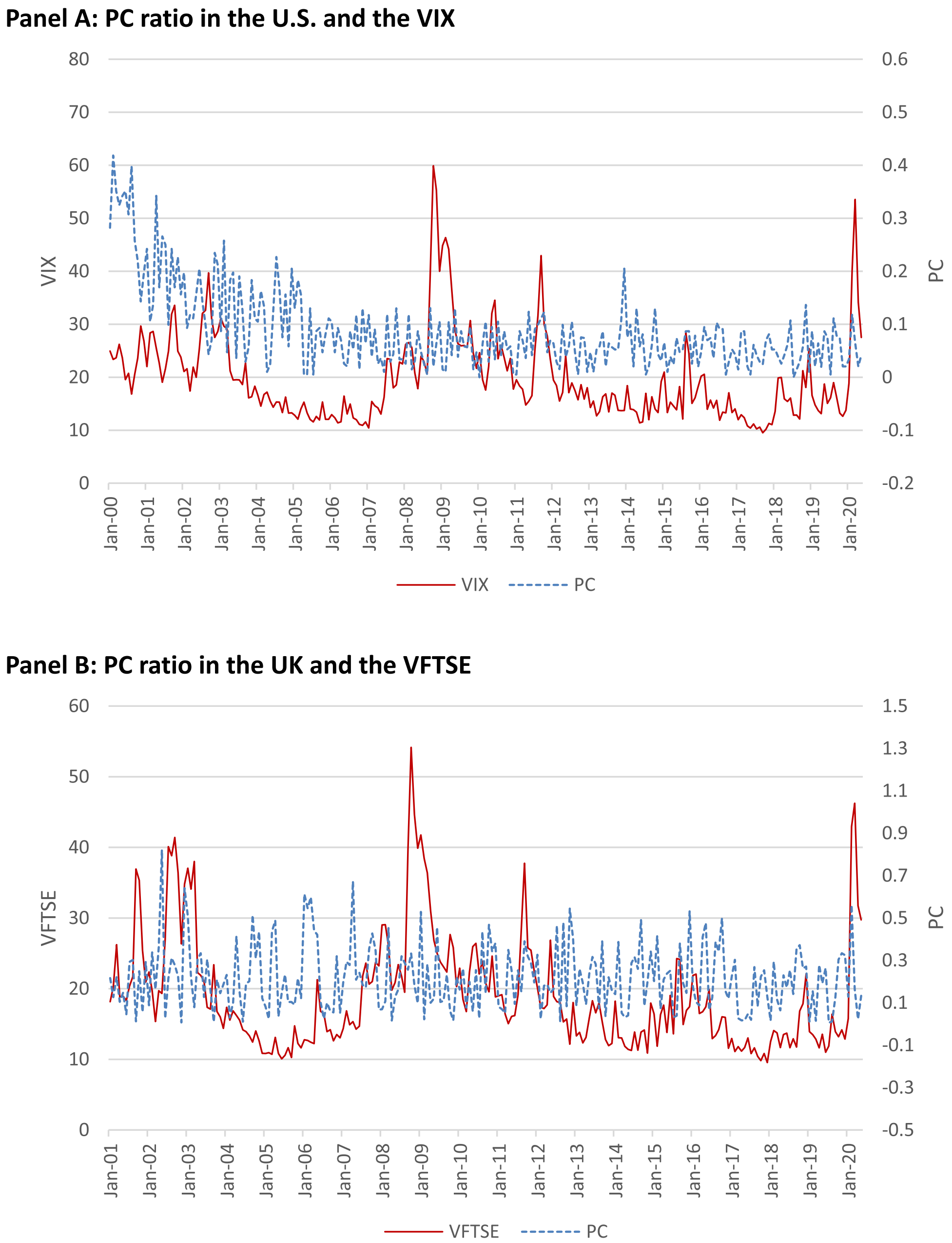

Fig. 3. Divergence in investors' opinions and implied volatility.
This figure presents the co-movement between the opinion divergence measure and the implied volatility index for the U.S. and UK markets. *PC* is calculated as |1-*P/C*|/(1 + *P/C*), where P/C is the put-call volume ratio of options traded on the CBOE exchange for the U.S. market and the put-call volume ratio of the FTSE100 index options for the UK market.

Table 1. Panels A and B present the variables applied over our sample periods.

The correlation matrix for the key independent variables is presented in Table 2. As part of our analysis, we examine the variable inflation factors to ensure that our results are not affected by a multicollinearity problem.

In order to find answer to our research questions, we examine the following model:

$$\log(VI_t) = \lambda_0 + \lambda_1 Uncertainty_t + \lambda_2 Quality_t + \lambda_3 Dispersion_t + \lambda_4 Bull\_spell_t + \lambda_5 Quality_t \cdot Uncertainty_t + \lambda_6 Dispersion_t \cdot Uncertainty_t + \lambda_7 Bull\_spell_t \cdot Uncertainty_t + \lambda_8 Rm_t + \lambda_9 Realized\_Volatility_t + \lambda_{10} Trend_t + \varepsilon_t, \quad (4)$$

where $\log(VI)_t$ is the logarithm of the implied volatility index (the VIX for the U.S.; the VFTSE for the UK) value at time *t;* $Quality_t$ is a proxy of quality of political signals. It is one of the variables *Qindex*, *EPUV*, or *WPFC*. $Dispersion_t$ is

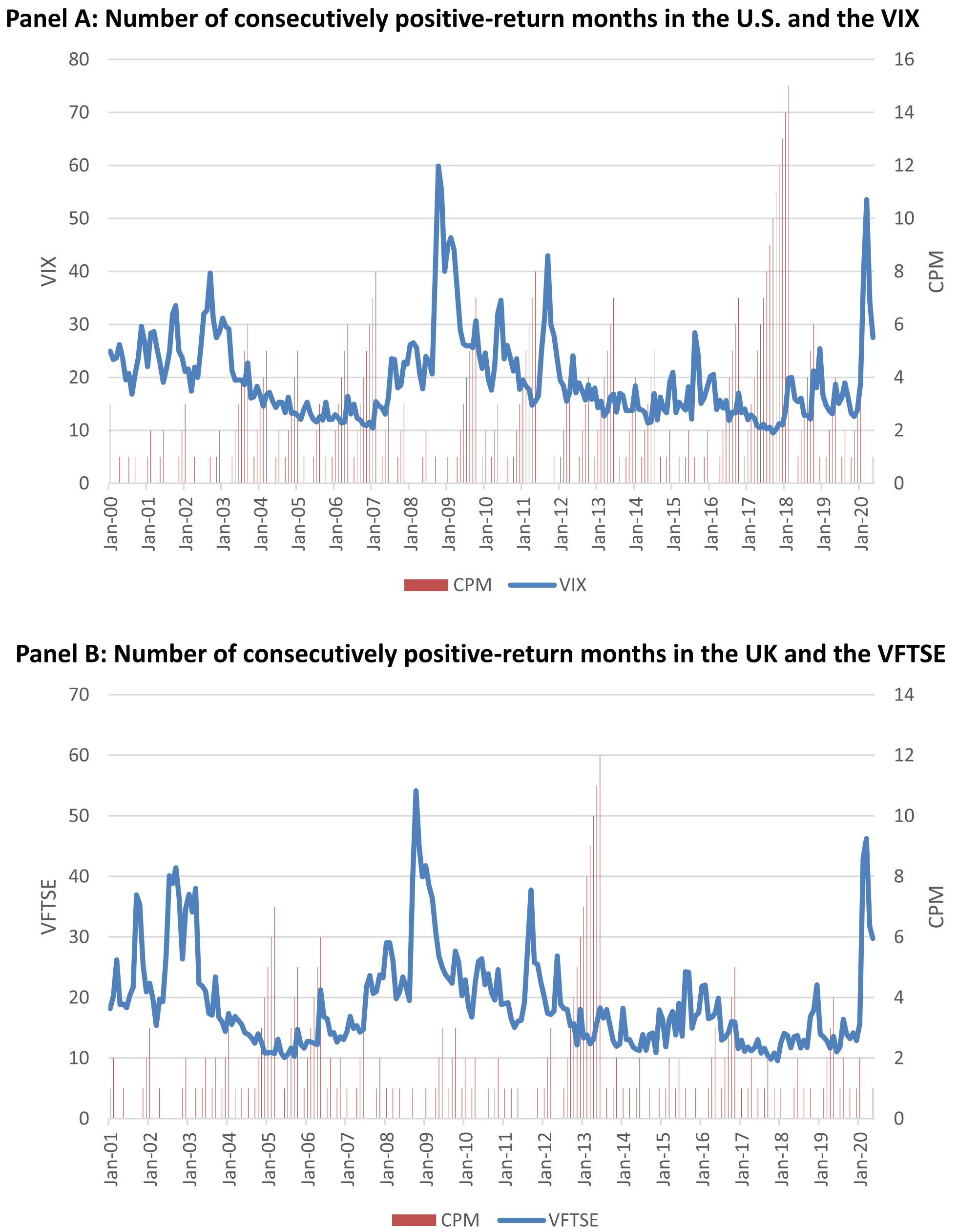

Fig. 4. Persistence of positive equity market performance and implied volatility.
This figure presents the co-movement between *CPM* and the implied volatility index for the U.S. and UK markets. *CPM* is the measure of a bullish market, defined as the number of consecutively positive-return months of the equity market index.

one of three variables *PC*, *ISD*, and *RSI* measuring investors' opinion divergence. $Bull\_spell_t$ is one of three proxies of bullish stock markets, *CPM*, *PM*, and *ES*. $Uncertainty_t$ is the measure for the degree of economic policy uncertainty at time t proxied by the monthly EPU scaled by 100. The list of control variables includes the daily log return of the S&P 500 or FTSE 100 index at time t (Rm_t); the logarithm of the annualized volatility of S&P 500 or FTSE 100 daily returns for a rolling one-month time period ($Realized\_Volatility_t$); and the time trend variable ($Trend_t$) to control for potentially omitted trending variables. Section 3 provides definitions of the key variables included in model (4).

5. Empirical results

In this section we present results of the analysis of factors affecting the relationship between an implied volatility index and economic policy uncertainty for the U.S. and the UK stock market separately. In the case of each market, we first consider the impact of each

Table 1
Summary statistics.

Variable	Description	Obs	Mean	Std. Dev.	5th Percentile	95th Percentile
Panel A: U.S. market						
VIX	CBOE VIX Index	5100	19.62	8.854	11.10	35.71
Uncertainty	Economic policy uncertainty index for the U.S.	5100	127.5	52.25	61.75	225.0
Qindex	Proxy for the quality of signals for the U.S. market	5100	100.5	18.31	80.84	134.8
EPUV	|Monthly U.S. EPU - mean of daily U.S. EPU within a given month|	5100	31.38	27.50	2.655	86.95
WPFC	The five-day moving average of the false misleading claims made by former President Trump reported by The Washington Post	811	15.13	12.38	2.200	38.80
PC	Calculated as|1-P/C|/(1 + P/C) where P/C is the CBOE put to call option volume ratio	5100	0.095	0.081	0.005	0.266
ISD	Calculated as | Bullish - Bearish |/(Bullish + Bearish), where Bullish and Bearish are the AAII sentiment percentages	5100	0.209	0.157	0.014	0.524
RSI	Calculated as |U.S. Valuation Confidence Index – 50|	5100	17.42	9.623	1.430	31.46
CPM	Number of consecutively positive-return months of S&P 500 Total Return Index	5100	2.107	2.646	0.000	7.000
PM	Number of positive-return months of S&P500 Total Return Index in the last six months	5100	3.889	1.323	2.000	6.000
ES	Calculated as the average of the returns below the 5th percentile of S&P500 daily returns in the past year	5100	−0.025	0.012	−0.055	−0.013
ΔS&P500	Log daily return of the S&P500 index	5100	0.000	0.012	−0.019	0.017
Realized_Volatility	Log value of the one-month realized volatility of the S&P500 index	5100	2.637	0.524	1.869	3.488
Panel B: UK market						
Variable	Description	Obs	Mean	Std. Dev.	5th Percentile	95th Percentile
VFTSE	FTSE100 implied volatility index	4886	19.08	8.915	10.51	37.77
Uncertainty	Economic policy uncertainty index for the UK	4886	128.9	72.26	42.88	246.8
Qindex	Proxy for the quality of signals for the UK market	4886	100.9	13.82	81.02	124.2
EPUV	|Monthly UK EPU - mean of daily UK EPU within a given month|	4886	159.0	91.22	51.90	300.2
PC	Calculated as |1-P/C|/(1 + P/C) where P/C is the put to call option volume ratio for the FTSE100 index	4886	0.206	0.148	0.016	0.476
CPM	Number of consecutively positive-return months of the FTSE100 index	4886	1.275	1.915	0.000	5.000
PM	Number of positive-return months of the S&P 500 index in the last six months	4886	3.354	1.217	1.000	5.000
ES	Calculated as the average of the returns below the 5th percentile of FTSE100 daily returns in the past year	4886	−0.025	0.011	−0.048	−0.012
ΔFTSE100	Log daily return of the FTSE100 index	4886	0.000	0.012	−0.018	0.017
Realized_Volatility	Log value of the one-month realized volatility of the FTSE100 index	4886	2.635	0.495	1.943	3.540

individual factor, and later we scrutinize the combined effect of the factors on the examined relationship.

5.1. U.S. market

In our first step, we examine the effects of policy uncertainty and political signals' quality on the VIX level for the U.S. market. We apply the three measures for the quality of political signals, namely the signal quality index (*Qindex*), EPU variability (*EPUV*), and the five-day moving average of the number of false claims (*WPFC*) reported by the *Washington Post*. Table 3 shows the regression estimate, with policy uncertainty proxied by the news-based EPU index (*Uncertainty*), the signal quality index (*Qindex*), EPU variability (*EPUV*), and the five-day moving average of the number of false claims (*WPFC*) divided by 100. The time fixed effects for each year are included in specifications (3), (6), and (9) to control for potential omitted time-variant variables. In all specifications, the parameter estimation is reported with Newey-West standard errors with one lag.[23]

The results in Table 3 indicate that the news-based EPU index (*Uncertainty*) has statistically significant and positive impacts on the VIX across all specifications, suggesting that the overall VIX tends to be higher in an environment where policy uncertainty is high. As presented in Table 3, the coefficients of the interaction terms for all three measures are statistically significant and negative in all specifications. It indicates that the impact of the EPU is lower when the political signals are more imprecise.

[23] We also tested our model with different numbers of lags and our results remain consistent.

Table 2
Correlation matrix for examined variables.

	Uncertainty	Qindex	EPUV	WPFC	PC	ISD	RSI	CPM	PM	ES	ΔS&P500
Panel A: Correlation matrix for U.S. variables											
Qindex	0.1889										
EPUV	0.4908	0.4434									
WPFC	0.1526	0.4571	0.2227								
PC	−0.0963	0.2500	−0.1107	0.0045							
ISD	−0.1161	0.1597	−0.1396	−0.0084	0.3103						
RSI	−0.1743	−0.4329	−0.4471	0.4965	−0.1248	0.0368					
CPM	−0.1668	0.1153	0.0388	−0.3496	−0.1008	−0.0602	−0.1419				
PM	−0.1754	0.0812	0.1346	−0.3434	−0.2004	−0.0985	−0.0495	0.6507			
ES	−0.2756	0.1406	0.0962	−0.4073	−0.0747	0.0143	−0.2437	0.2103	0.3954		
ΔS&P500	−0.0335	−0.0100	−0.0016	0.0135	0.0730	0.0024	0.0072	0.0086	0.0103	0.0026	
Realized_Volatility	0.3466	−0.1142	−0.0932	0.2101	0.1551	−0.001	0.1551	−0.4815	−0.6105	−0.6240	−0.0161

Panel B: Correlation matrix for the UK variables

	Uncertainty	Qindex	EPUV	PC	CPM	PM	ES	ΔFTSE100
Qindex	0.5777							
EPUV	0.4110	0.2679						
PC	−0.1095	−0.0725	−0.0541					
CPM	−0.1026	−0.0235	−0.0859	0.0177				
PM	−0.1386	0.0656	−0.2136	0.0293	0.6136			
ES	−0.1548	−0.1160	−0.4380	0.0319	0.1834	0.3934		
ΔFTSE100	−0.0117	0.0022	−0.0011	−0.0946	−0.0045	0.0129	−0.0035	
Realized_Volatility	0.2078	0.0415	0.4246	−0.0526	−0.2905	−0.5527	−0.6698	0.0069

Table 2 presents the correlation matrix of independent variables for the United States in Panel A and the UK in Panel B. *Uncertainty* is the economic policy uncertainty index by BBD then divided by 100; *Qindex* is the index constructed to measure the quality of political signals; *EPUV* is the absolute difference between monthly EPU and the average daily EPU within the month; *WPFC* is the five-day moving average of the false or misleading claims made by former President Donald J. Trump reported by *The Washington Post* newspaper; *PC* is calculated as $|1-P/C|/(1+P/C)$, where *P/C* is the put-call option volume ratio; *ISD* is calculated as $|$ *Bullish - Bearish* $|/($*Bullish* + *Bearish*$)$, where *Bullish* and *Bearish* are the AAII sentiment percentages, respectively; *RSI* is calculated as |U.S. Valuation Confidence Index − 50| for the United States; *CPM* is defined as the number of consecutively positive-return months of the equity market index; *PM* is the number of positive-return months of the equity market in the last six months; *ES* is the 5% expected shortfall of the equity market index calculated as the average of the returns below the 5th percentile of daily returns in the past year; *ΔS&P500* is the log daily return of the S&P 500 index; *ΔFTSE100* is the log daily return of the FTSE 100 index.

Using coefficients reported in Table 3 (see specification (1)), we estimate that, if *Qindex* increases by one standard deviation (18.31 see Table 1), the relationship between *Uncertainty* on log*(VIX)* is weakened by approximately 54%. The result is consistent with the implications of the study by Pástor and Veronesi (2013). Thus, low-quality political signals weaken the relationship between market volatility and economic policy uncertainty. In addition, the coefficients of *Qindex, EPUV*, and *WPFC* are all found to be highly significant and positive, which suggests that the sign of the combined impacts of political signals' quality and its interaction term on the level of the VIX depends on the magnitude of policy uncertainty (*Uncertainty*).

With regard to control variables, we show in Table 3 that the coefficient for the daily return of the S&P 500 index (*ΔS&P500*) is negative and statistically significant, which indicates higher returns of the equity market index reduces the log level of the fear gauge. Not surprisingly, the log value of realized volatility is found to be statistically significant and positive, which indicates that higher recent realized volatility increases the VIX.

To answer our second question, we next examine the impacts of investors' opinion divergence on the relationship between the VIX and economic policy uncertainty in the United States. The results are presented in Table 4. In specifications (1), (2) and (3), *PC* ratio is employed to measure opinion divergence. Specifications (4), (5) and (6) include the variation of AAII sentiments (*ISD*) as the proxy, while specifications (7), (8) and (9) apply *RSI* measuring investors' opinion disagreement. Recall that a high value of *PC, ISD,* and *RSI* indicates a dominant market sentiment, and therefore a high opinion consensus (low opinion divergence) among investors. As shown in Table 4, the coefficients of interaction terms with *Uncertainty* for all three measures in all specifications are statistically significant and positive, indicating that a low level of opinion divergence among investors (proxied by high values in *PC, ISD,* and *RSI*) tends to raise the correlation between EPU and the VIX level in the United States. The coefficients estimated in Table 4 specification (1) implies that, if *PC* increases by one standard deviation (0.081), the link between *Uncertainty* on log*(VIX)* is strengthened by approximately 8%. In other words, it suggests that higher divergence among investors' opinions (proxied by low values of our measures) weakens the relationship between the EPU and the VIX. This might be explained by the fact that when investors disagree on the effects of political signals released, they behave differently in the equity market. For instance, investors who expect down pressure from political signals will take short positions, while those who interpret the same signals positively will take long positions. When the opinion divergence is high,

Table 3
The effect of the quality of political signals on the relationship between economic policy uncertainty and VIX.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Qindex	0.9348***	0.2806***	0.2933***						
	(0.000)	(0.000)	(0.000)						
Qindex × Uncertainty	−0.9750***	−0.2770***	−0.2168***						
	(0.000)	(0.000)	(0.000)						
EPUV				−0.3562***	0.1477***	0.1408***			
				(0.000)	(0.000)	(0.001)			
EPUV × Uncertainty				−0.1223***	−0.1499***	−0.1043***			
				(0.000)	(0.000)	(0.000)			
WPFC							1.7890***	0.6608**	0.6798***
							(0.000)	(0.028)	(0.006)
WPFC × Uncertainty							−0.8844***	−0.4182**	−0.4240***
							(0.000)	(0.021)	(0.004)
Uncertainty	1.3108***	0.4281***	0.3414***	0.4704***	0.2122***	0.1682***	0.5502***	0.1962***	0.2030***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ΔS&P500		−3.2791***	−3.1906***		−3.2419***	−3.1806***		−4.0585***	−3.8195***
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Realized_Volatility		0.5275***	0.4218***		0.5288***	0.4210***		0.4010***	0.3750***
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Trend		−0.0000***	0.0001**		−0.0000***	0.0000		0.0002***	0.0002**
		(0.000)	(0.039)		(0.000)	(0.193)		(0.000)	(0.010)
_cons	1.5563***	1.2395***	1.2341***	2.4695***	1.4420***	1.5737***	1.7079***	0.3212	−0.2933
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.187)	(0.663)
Year Fixed Effect	NO	NO	YES	NO	NO	YES	NO	NO	YES
Adj.R-squared	0.248	0.818	0.870	0.297	0.821	0.871	0.299	0.823	0.836
N	5100	5100	5100	5100	5100	5100	811	811	811

Table 3 presents the results on how the quality of political signals affects the link between the VIX and economic policy uncertainty for the United States over the period January 2000 to March 2020. The dependent variable is the log value of the VIX; *Uncertainty* is the economic policy uncertainty index divided by 100; *Qindex* is the value of the index constructed to measure the quality of political signals divided by 100; *EPUV* is the second signal quality measure calculated as the absolute difference between monthly EPU and the average daily EPU within the month, then divided by 100; *WPFC* is the third signal quality measure as the five-day moving average of the false or misleading claims made by former President Donald J. Trump reported by the *Washington Post* newspaper divided by 100; *ΔS&P500* is the log daily return of the S&P 500 index; *Realized_Volatility* is the logarithm value of one-month realized volatility of the S&P 500 index; *Trend* is the time trend variable. Newey-West standard errors with one lag are estimated and *p*-values are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

the number of investors in each group is roughly equal, and therefore the net change in the market is likely to be small. It is worth to mention that the coefficients for the proxies (*PC, ISD,* and *RSI*) are found to be statistically significant and negative, which suggests that the sign of the combined impacts of opinion disagreement and its interaction with policy uncertainty on the VIX level could vary with the level of policy uncertainty (*Uncertainty*).

To examine the effects of bullish stock markets, we test whether an environment characterized by good market performance impacts the relationship between policy uncertainty and the CBOE VIX level. In Table 5, we include the measure of a bullish market, *CPM*, defined as the number of consecutively positive-return months of the S&P 500 Total Return Index in specifications (1), (2) and (3). We use *PM*, defined as the number of positive-return months of the S&P 500 Total Return Index in the last six months as the proxy in specifications (4), (5) and (6). In specifications (7), (8) and (9), we employ the tail risk measure, *ES*, calculated as the average of the S&P 500 Index's returns below or equal to the 5th percentile of daily returns in the past year (252 trading days). As shown in Table 5, in all specifications, the interaction terms between bullish spell measures (*CPM, PM, ES*) and *Uncertainty* are found to be statistically significant and negative, which indicates the link between the VIX level and U.S. EPU is weakened when the equity market is dominated by bullish investors and the frequency of substantial negative returns is very low. The coefficients estimated in Table 5 specification (1) implies that, if *CPM* increases by one month, the relationship between *Uncertainty* on log*(VIX)* is weakened by approximately 25%. Our findings provide evidence that the performance of the equity market has a similar role as good economic conditions on the examined relationship of the fear gauge and economic policy uncertainty.[24]

In the final step of analysis for the U.S. market, we test the factors implied by the three theories simultaneously by running the regression models with different permutations of the factors' proxies as robustness tests. Specifically, we apply different proxies for each factor and present the coefficient estimation for the interaction terms based on various combinations of our measures. Panels A, B, and C in Table 6 show the test results for the quality of political signals, opinion divergence, and equity market performance, respectively. Table 6 presents the coefficient estimation for the interaction terms between the factor

[24] As one of our robustness tests, we followed the approach of Balli and Sørensen (2013) and included the square term of *Uncertainty* and the square of a factor's proxy. The coefficient for the interaction term remains statistically significant with a consistent sign. The results are presented in Appendix F.

Table 4
The effect of investors' opinion divergence on the relationship between economic policy uncertainty and VIX.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PC	0.5293***	−0.3311***	−0.3930***						
	(0.000)	(0.000)	(0.000)						
PC × Uncertainty	0.3050**	0.1934***	0.1793***						
	(0.014)	(0.004)	(0.005)						
ISD				−0.0862	−0.2179***	−0.1620***			
				(0.417)	(0.000)	(0.001)			
ISD × Uncertainty				0.2005**	0.1589***	0.0936**			
				(0.042)	(0.001)	(0.019)			
RSI							−2.1492***	−0.9060***	−0.0663
							(0.000)	(0.000)	(0.583)
RSI × Uncertainty							2.4257***	0.8427***	0.3743***
							(0.000)	(0.000)	(0.000)
Uncertainty	0.2689***	0.1215***	0.1042***	0.2495***	0.1074***	0.1016***	−0.1318***	0.0015	0.0639***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.926)	(0.000)
ΔS&P500		−3.1778***	−3.0722***		−3.2307***	−3.1794***		−3.1976***	−3.1611***
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Realized_Volatility		0.5379***	0.4232***		0.5367***	0.4225***		0.5072***	0.4081***
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Trend		−0.0000***	0.0001		−0.0000***	0.0001*		−0.0000***	0.0001*
		(0.000)	(0.169)		(0.000)	(0.064)		(0.000)	(0.074)
_cons	2.4715***	1.5679***	1.6956***	2.5482***	1.5771***	1.6151***	2.9248***	1.7691***	1.6507***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year Fixed Effect	NO	NO	YES	NO	NO	YES	NO	NO	YES
Adj.R-squared	0.194	0.813	0.870	0.162	0.813	0.869	0.294	0.822	0.872
N	5100	5100	5100	5100	5100	5100	5100	5100	5100

Table 4 presents the results on how investors' opinion divergence affects the link between the VIX and economic policy uncertainty for the United States over the period January 2000 to March 2020. The dependent variable is the log value of the VIX; *Uncertainty* is the economic policy uncertainty index divided by 100; *PC* is calculated as |1-*P/C*|/(1 + *P/C*), where *P/C* is the put-call volume ratio of options traded on the CBOE exchange; *ISD* is the deviation of individual sentiments, calculated as | *Bullish* - *Bearish* |/(*Bullish* + *Bearish*), where *Bullish* and *Bearish* are the AAII sentiment percentages, respectively; *RSI* is calculated as absolute difference between Robert Shiller's Valuation confidence index and 50, then divided by 100; Δ*S&P500* is the log daily return of the S&P 500 index; *Realized_Volatility* is the logarithm value of one-month realized volatility of S&P 500 index; *Trend* is the time trend variable. Newey-West standard errors with one lag are estimated and *p*-values are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

measures and *Uncertainty*.[25] These results are obtained by running regressions of 27 permutations of different factor measures for the U.S. market, with each regression including all three factor variables, their interaction terms with *Uncertainty*, and control variables.

Table 6, Panel A, shows that whichever proxy is selected the results are robust— that a low-quality signal weakens the relationship between VIX and economic policy uncertainty. Table 6, Panels B and C, reports the interaction terms for opinion divergence and a bullish market, respectively. Panel B mostly confirms that higher divergence among investors' opinions (proxied by low values of our measures) weakens the relationship between the EPU and the VIX. In Panel C, we reported interaction coefficients between the stock market performance measures and *Uncertainty*. As expected, the results show that a very good performance of the stock market weakens the examined relationship. Overall, the results in Table 6 are in line with those reported in Tables 3–5 where we tested the theories one by one.

5.2. UK market

Next, we examine the factors affecting the relationship between the implied volatility index VFTSE and the UK EPU index. In the case of the UK, we consider two proxies for the quality of political signals, one for opinion divergence, and three proxies for stock market performance.[26]

In Table 7, we report results for each of the theories separately. As in the case of the findings from the U.S. market, we show that the coefficients of the signal-quality interaction terms (*Qindex, EPUV*) with *Uncertainty* are negative and statistically significant, indicating that the imprecision of political signals weakens the link between the VFTSE and the news-based EPU in the UK market. The coefficients of the interaction term between *PC* and *Uncertainty* in Table 7 are statistically significant and positive. This is consistent with the findings for the U.S. market, and indicates that higher opinion divergence (proxied by lower *PC*) weakens the link between the VFTSE and the UK EPU index. Moreover, the coefficients of the interaction terms between the stock performance measures (i.e., *CPM, PM, ES*) and *Uncertainty* are found to be statisti-

[25] For reasons of brevity, we only report the coefficient estimates of the interaction terms. The complete regression results are available upon request.

[26] The reasons for the smaller number of measures for the UK market were discussed in Section 3.

Table 5
The effect of equity market performance on the relationship between economic policy uncertainty and VIX.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CPM	0.0096	0.0072*	0.0092**						
	(0.247)	(0.097)	(0.039)						
CPM × Uncertainty	−0.0497***	−0.0016	−0.0073**						
	(0.000)	(0.639)	(0.045)						
PM				0.0119	0.0285***	0.0320***			
				(0.321)	(0.000)	(0.000)			
PM × Uncertainty				−0.1305***	−0.0407***	−0.0418***			
				(0.000)	(0.000)	(0.000)			
ES							−9.9111***	−8.4847***	−7.4069***
							(0.000)	(0.000)	(0.000)
ES × Uncertainty							−8.5141***	−0.6885	−2.4310***
							(0.000)	(0.114)	(0.000)
Uncertainty	0.2969***	0.1419***	0.1277***	0.7235***	0.2867***	0.2672***	−0.0766***	0.1089***	0.0481**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.000)	(0.010)
ΔS&P500		−3.2635***	−3.1900***		−3.2582***	−3.2047***		−3.3405***	−3.2048***
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Realized_Volatility		0.5482***	0.4236***		0.5074***	0.4029***		0.4040***	0.3450***
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Trend		−0.0000***	0.0001*		−0.0000***	0.0001		−0.0000***	0.0001*
		(0.000)	(0.087)		(0.000)	(0.127)		(0.000)	(0.055)
_cons	2.6231***	1.4885***	1.5702***	2.5624***	1.4523***	1.5408***	2.4679***	1.6935***	1.6149***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year Fixed Effect	NO	NO	YES	NO	NO	YES	NO	NO	YES
Adj.R-squared	0.298	0.813	0.869	0.488	0.818	0.874	0.595	0.866	0.887
N	5100	5100	5100	5100	5100	5100	5100	5100	5100

Table 5 presents the results on how the performance of the equity market affects the link between the VIX and economic policy uncertainty for the United States over the period January 2000 to March 2020. The dependent variable is the log value of the VIX; *Uncertainty* is the EPU index divided by 100; *CPM* is defined as the number of consecutively positive-return months of the S&P 500 index; *PM* is the number of positive-return months of the S&P 500 index in the last six months; *Realized_Volatility* is the logarithm value of one-month realized volatility of the market index; *ES* is the 5% expected shortfall of the S&P500 index calculated as the average of the returns below the 5th percentile of daily returns in the past year (252 trading days); *ΔS&P500* is the log daily return of the S&P 500 index; *Realized_Volatility* is the logarithm value of one-month realized volatility of the S&P 500 index; *Trend* is the time trend variable. Newey-West standard errors with one lag are estimated and *p*-values are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 6
The combined effect of factors on the relationship between the U.S. EPU and the VIX.

Panel A: Quality of political signals

Estimated coefficient λ_5	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Qindex × Uncertainty	−0.2676***	−0.2462***	−0.1428***	−0.1804***	−0.1627***	−0.1098**	−0.2537***	−0.2272***	−0.2158***
	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.019)	(0.000)	(0.000)	(0.000)
EPUV × Uncertainty	−0.1044***	−0.1045***	−0.0857***	−0.0541**	−0.0506**	−0.0436*	−0.0914***	−0.0926***	−0.0977***
	(0.000)	(0.000)	(0.000)	(0.015)	(0.021)	(0.052)	(0.000)	(0.000)	(0.000)
WPFC × Uncertainty	−0.5820***	−0.5189***	−0.5357***	−0.5222***	−0.4699***	−0.4722***	−0.1774	−0.1869	−0.2938*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.218)	(0.228)	(0.055)
Measure of opinion divergence	PC	ISD	RSI	PC	ISD	RSI	PC	ISD	RSI
Measure of bullish market	CPM	CPM	CPM	PM	PM	PM	ES	ES	ES
Year fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Panel B: Opinion divergence

Estimated coefficient λ_6	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PC × Uncertainty	0.2556***	0.1016	0.0658	0.1396**	0.0456	0.1315	0.3049***	0.1728***	0.4716**
	(0.000)	(0.124)	(0.743)	(0.049)	(0.516)	(0.527)	(0.000)	(0.003)	(0.019)
ISD × Uncertainty	0.1183***	0.0808**	0.2926**	0.0977**	0.0751*	0.2418**	0.0970***	0.0699**	0.0155
	(0.004)	(0.034)	(0.017)	(0.015)	(0.054)	(0.045)	(0.008)	(0.038)	(0.906)
RSI × Uncertainty	0.2527***	0.2027**	−0.2019	0.1443	0.1700**	−0.1031	−0.0064	−0.0007	1.1653**
	(0.007)	(0.016)	(0.621)	(0.119)	(0.046)	(0.866)	(0.944)	(0.993)	(0.013)
Measure of quality of signals proxy	Qindex	EPUV	WPFC	Qindex	EPUV	WPFC	Qindex	EPUV	WPFC
Measure of bullish market	CPM	CPM	CPM	PM	PM	PM	ES	ES	ES
Year fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

(*continued on next page*)

Table 6 (*continued*)

Panel C: Bullish market

Estimated coefficient λ_7	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CPM × Uncertainty	−0.0094***	−0.0075**	−0.0339***	−0.0102***	−0.0080**	−0.0393***	−0.0075**	−0.0065*	−0.0349***
	(0.008)	(0.040)	(0.000)	(0.004)	(0.027)	(0.000)	(0.035)	(0.072)	(0.000)
PM × Uncertainty	−0.0352***	−0.0349***	−0.0851***	−0.0374***	−0.0357***	−0.0994***	−0.0345***	−0.0319***	−0.0892**
	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.014)
ES × Uncertainty	−2.5006***	−2.3821***	−3.4162**	−2.5011***	−2.3506***	−3.1675*	−2.4398***	−2.2668***	−1.1961
	(0.000)	(0.000)	(0.028)	(0.000)	(0.000)	(0.058)	(0.000)	(0.000)	(0.405)
Measure of quality of signals proxy	Qindex	EPUV	WPFC	Qindex	EPUV	WPFC	Qindex	EPUV	WPFC
Measure of opinion divergence	PC	PC	PC	ISD	ISD	ISD	RSI	RSI	RSI
Year fixed effect	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES

Table 6 reports the estimated slope coefficients from the following regression specifications as robustness tests:

$$\log(VIX_t) = \lambda_0 + \lambda_1 Uncertainty_t + \lambda_2 Quality_t + \lambda_3 Dispersion_t + \lambda_4 Bull\_spell_t + \lambda_5 Quality_t \cdot Uncertainty_t + \lambda_6 Dispersion_t \cdot Uncertainty_t + \lambda_7 Bull\_spell_t \cdot Uncertainty_t + \lambda_8 \Delta S\&P500_t + \lambda_9 Realized\_Volatility_t + \lambda_{10} Trend_t + \varepsilon_t$$

Specifically, Panel A reports the estimation of coefficient λ_5, Panel B reports the estimation of coefficient λ_6, and Panel C reports the estimation of coefficient λ_7. These results are obtained by running regressions of 27 permutations of different factor measures for the United States over the period January 2000 to March 2020. Each regression includes all three factor variables and their interaction terms with *Uncertainty*. The dependent variable is the log value of the VIX; *Uncertainty* is the economic policy uncertainty index divided by 100. We use three proxies for the quality of political signals $Quality_t$: the value of index constructed to measure the quality of political signals (*Qindex*) divided by 100; the absolute difference between monthly EPU and the average daily EPU within the month (*EPUV*), then divided by 100; the five-day moving average of the false or misleading claims made by former President Donald J. Trump reported by *The Washington Post* newspaper (*WPFC*), then divided by 100. We use three measures for investors' opinion divergence $Dispersion_t$: the option volume deviation ratio (*PC*) calculated as |1-*P/C*|/(1 + *P/C*) where *P/C* is the put-call volume ratio of options traded on the CBOE exchange; the deviation of AAII individual sentiments percentages (*ISD*), calculated as | Bullish - Bearish |/(*Bullish* + *Bearish*), where *Bullish* and *Bearish* are the AAII sentiment percentages respectively; absolute value of the difference between Robert Shiller's U.S. Valuation Confidence Index and 50 (*RSI*). We use three proxies for exceptional market performance $Bull\_spell_t$: the number of consecutive positive-return months of S&P 500 Total Return Index (*CPM*); the number of positive-return months of S&P 500 Total Return Index in the last six months (*PM*); the 5% expected shortfall of the S&P500 index calculated as the average of the returns below the 5th percentile of daily returns in the past year (*ES*). Other control variables include the log daily return S&P 500 index, $\Delta S\&P500$; the logarithm value of one-month realized volatility of S&P 500 index, *Realized_Volatility*; and the time trend variable, *Trend*. Newey-West standard errors with one lag are estimated and p-values are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 7
Analysis of factors affecting the relationship between economic policy uncertainty and implied volatility for the UK market.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Qindex × Uncertainty	−0.9104***	−0.2044***										
	(0.000)	(0.000)										
EPUV × Uncertainty			−0.0745***	−0.0316***								
			(0.000)	(0.000)								
PC × Uncertainty					0.3504***	0.0969**						
					(0.000)	(0.011)						
CPM × Uncertainty							−0.0234***	−0.0123***				
							(0.000)	(0.000)				
PM × Uncertainty									−0.0512***	−0.0311***		
									(0.000)	(0.000)		
ES × Uncertainty											−8.4494***	−0.4757
											(0.000)	(0.614)
Year Fixed Effect	No	YES	No	YES	No	YES	No	YES	No	YES	No	YES
Controls	No	YES	No	YES	No	YES	No	YES	No	YES	No	YES
Adj.R-squared	0.110	0.858	0.226	0.860	0.032	0.857	0.099	0.857	0.330	0.865	0.605	0.871
N	4886	4886	4886	4886	4886	4886	4886	4886	4886	4886	4886	4886

Table 7 presents the results for the UK over the period January 2001 to May 2020. The dependent variable is the log value of the implied volatility index-VFTSE; *Uncertainty* is the economic policy uncertainty index by BBD divided by 100; *Qindex* is the value of the index constructed to measure the quality of political signals, divided by 100; *EPUV* is the absolute difference between monthly EPU and the average daily EPU within the month, then divided by 100; *PC* is calculated as |1-*P/C*|/(1 + *P/C*) where *P/C* is the put-call volume ratio of the FTSE 100 index option; *CPM* is defined as the number of consecutively positive-return months of the FTSE 100 index; *PM* is the number of positive-return months of the FTSE 100 index in the last six months; *ES* is the 5% expected shortfall of the FTSE100 index calculated as the average of the returns below the 5th percentile of daily returns in the past year (252 trading days); Control variables include: $\Delta FTSE100$, the log daily return of the FTSE 100 index; *Realized_Volatility,* the logarithm value of one-month realized volatility of the FTSE 100 index; *Trend,* the time trend variable. Newey-West standard errors with one lag are estimated and *p*-values are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

cally significant and negative, suggesting that the link is weaker during periods when the stock market performed well.

As a robustness test, we present the results for the UK, when the proxies of the three theories are considered all at once (see Appendix D).[27] The coefficients for all interaction terms are in line with the results reported in Table 7 and those obtained for the U.S. market.

As another robustness test for both markets, we conducted a principal components analysis for each group of measures, and used the first principal component as the proxy for each factor in our regression models. The results are shown in Appendix E and are consistent with our previous findings.

6. Conclusion

This study investigates the factors affecting the relationship between implied market volatility and economic policy uncertainty. We find evidence from the U.S. and UK markets that the combination of the quality of political/economic signals, investors' opinion divergence, and bullish market influences the link between the fear gauge and economic policy uncertainty.

Specifically, we document that low-quality political signals consistently weaken the positive relationship between market volatility and policy uncertainty. These findings are in line with the implications of the theoretical models of Pástor and Veronesi (2013). We also find that the link between market volatility and policy uncertainty gets weaker in an environment with high opinion divergence among investors and exceptional performance of the stock market. In addition, we show that the combined effects of those factors together with policy uncertainty on market volatility depend on the overall level of economic policy uncertainty. To sum up, we find that the commonly accepted positive relationship between market volatility and economic policy uncertainty is affected by these three identified factors and is subject to changes over time.

Appendix A. Construction and properties of Qindex as the measure of the quality of political signals

In principle, the idea of *Qindex* is based on the approach proposed in the paper by Baker et al. (2016). Using a search engine of a Dow Jones product, the *Factiva* database, we scanned the digital archives of each of the selected U.S. and UK newspapers to find a monthly count of articles containing terms belonging to all three categories: quality, signal, and policy, The list of terms is given below and we sourced them from *The New Collins Thesaurus* (see McLeod, 1984).

Terms for the U.S. market and newspapers

Quality terms: ambiguous, false, wrong, concocted, erroneous, faulty, fictitious, improper, inaccurate, incorrect, inexact, invalid, mistaken, unfounded, unreal, misleading, confusing, confused, lying, unreliable, unsound, untrustworthy, untruthful, deceitful, deceptive, delusory, disingenuous, and evasive.

Signal terms: signal, signals, claim, claims, statement, statements, announcement, announcements, policy, policies, news, sign, signs, declaration, declarations, explanation, proclamation, recital, report, reports, information, press, bill, bills, release, and releases.

Policy terms: government, president, regulation, deficit, legislation, congress, white house, Federal Reserve, the Fed, regulations, regulatory, deficits, congressional, legislative, and legislature.

Terms for the UK market and newspapers

Quality terms: ambiguous, false, wrong, concocted, erroneous, faulty, fictitious, improper, inaccurate, incorrect, inexact, invalid, mistaken, unfounded, unreal, misleading, confusing, confused, lying, unreliable, unsound, untrustworthy, untruthful, deceitful, deceptive, delusory, disingenuous, and evasive.

Signal terms: signal, signals, claim, claims, statement, statements, announcement, announcements, policy, policies, news, sign, signs, declaration, declarations, explanation, proclamation, recital, report, reports, information, press, bill, bills, release, and releases.

Policy terms: government, prime minister, regulation, deficit, legislation, congress, regulations, regulatory, deficits, congressional, legislative, legislature, tax, spending, Bank of England, and budget.

Fig. A.1 shows two examples of press articles that contain terms belonging to all three categories and used to construct the *Qindices*.

Below, we briefly discuss the properties of the constructed *Qindices* for both markets. Fig. A.2, Panel A, shows fluctuations of the U.S. *Qindex* and EPU index. The analysis of the graph reveals a couple of interesting observations. First, the two indices are very distinctive and the EPU index is characterized by higher variability, particularly after 2001. The U.S. *Qindex* reached high values around the election of President George W. Bush in 2000; the time coincides with the Florida election recount of 2000, which occurred during the weeks after the 2000 U.S. presidential election. In the early months of the Iraq War, the value of the index goes up, indicating a lower quality of political signals.[28] The spike in February 2004 corresponds to the time when the CIA admitted that there was no imminent threat from weapons of mass destruction before the 2003 invasion of Iraq. The value of the *Qindex* drops

[27] Due to the fact that the number of measures of each factor are different for the UK (two for signal quality, one for opinion divergence; three for bullish market) in comparison with the United States (three for signal quality, three for opinion divergence; three for bullish market), we present results with all six possible permutations applied in the UK market in Table 8.

[28] "The first casualty when war comes is truth", Hiram W Johnson, senator for California, to the U.S. Senate in 1917, seems to be at least a partial explanation of it.

The Washington Post

National-Politics
Mixed signals, reversals cloud second day of G-7 summit

By Damian Paletta;Josh Dawsey;Toluse Olorunnipa;Michael Birnbaum
26 August 2019
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BIARRITZ, France — A summit of world leaders devolved into a **confusing** spectacle on Sunday when **President** Trump signaled regret for his trade war with China only to have the **White House** reverse his position hours later.

It was one of numerous surprises on a day when some officials had hoped for clarity or consensus. Leaders continued squabbling about whether Russian **President** Vladimir Putin would attend a future meeting, and French officials surprised others by inviting Iran's foreign minister to this seaside town, an unusual move of diplomatic jujitsu in the tightly scripted world of international summits.

Leaders who were hoping that global tensions over trade, North Korea and China might be eased on the second day of the Group of Seven summit were disappointed during a whiplash day of mixed **signals**. Some European officials said they were beginning to fear that nearly any substantive coordinated work with the United States might be impossible in the Trump era.

THE SUNDAY TIMES

Focus
Do the maths: the real price of belonging to the EU

David Smith
28 February 2016
© Times Newspapers Limited 2016

It is what should be the most straightforward argument in the referendum debate: how much does British membership cost us, and what do we get back in return, writes David Smith, Economics Editor. “Leave” campaigners started the ball rolling with the eye-catching **claim** that membership costs Britain £55m a day, and that a Brexit vote would mean this money could be spent in Britain, on schools, hospitals and services to benefit British people.

A £55m-a-day cost — more than £350m a week, or almost £20bn a year — is arresting but it is also highly **misleading**. It is derived from a figure produced by the Office for National Statistics (ONS) in its annual balance of payments yearbook (the “pink book”) under UK payments to EU institutions. But the ONS says that, because that figure is calculated for balance of payments purposes, it is **wrong** to use it for Britain’s contribution.

The “true” figure for Britain’s EU**budget** outgoings was £17.8bn last year. That is still quite a hefty amount, equivalent to £49m a day. To use that as the cost of Britain’s EU membership would also, however, be **misleading**.

Britain automatically benefits from the **budget** rebate tenaciously negotiated by Margaret Thatcher when she was **prime minister**, and agreed at the Fontainebleau summit in France in 1984. Last year her rebate knocked £4.9bn off Britain’s contribution, cutting the annual amount to £12.9bn and the daily total to £35m.

Fig. A.1. Examples of matched articles used to construct Qindex.
Source: Dow Jones Factiva.

by mid-2004, and remains stable until late 2016. Since then, the U.S. *Qindex* exhibits an almost constant uptrend, indicating a period of low quality of political signals. The U.S. *Qindex* reached its highest level in the last 15 years with the outbreak of COVID-19 in 2020. The analysis of the UK *Qindex* (see Fig. A.2, Panel B) reveals that it increased post the 2015 general election.[29] It reached a high level in June 2016 (at the time of the 2016 UK European Union membership referendum), and remained on an elevated level until early 2019. The historical maximum levels were reached in Q1 2020 when the UK was hit by the COVID-19 pandemic. The study by Altig et al. (2020) discussed reasons why the paths of the U.S. EPU index and the VIX index may differ during the pandemic.

[29] Post the Brexit referendum, the full extent of noisy political signals has been revealed by a number of articles published by UK media over 2015–2020 (e.g., "Brexit: Pulling the Signal Out of the Noise," "The Brexit Effect: The Signals amidst the Noise," "The signal from the noise," "Brexit update Signals in the noise," "Noise but no breakthrough as Johnson, Juncker talk Brexit," "Plenty of noise but no breakthrough on Brexit").

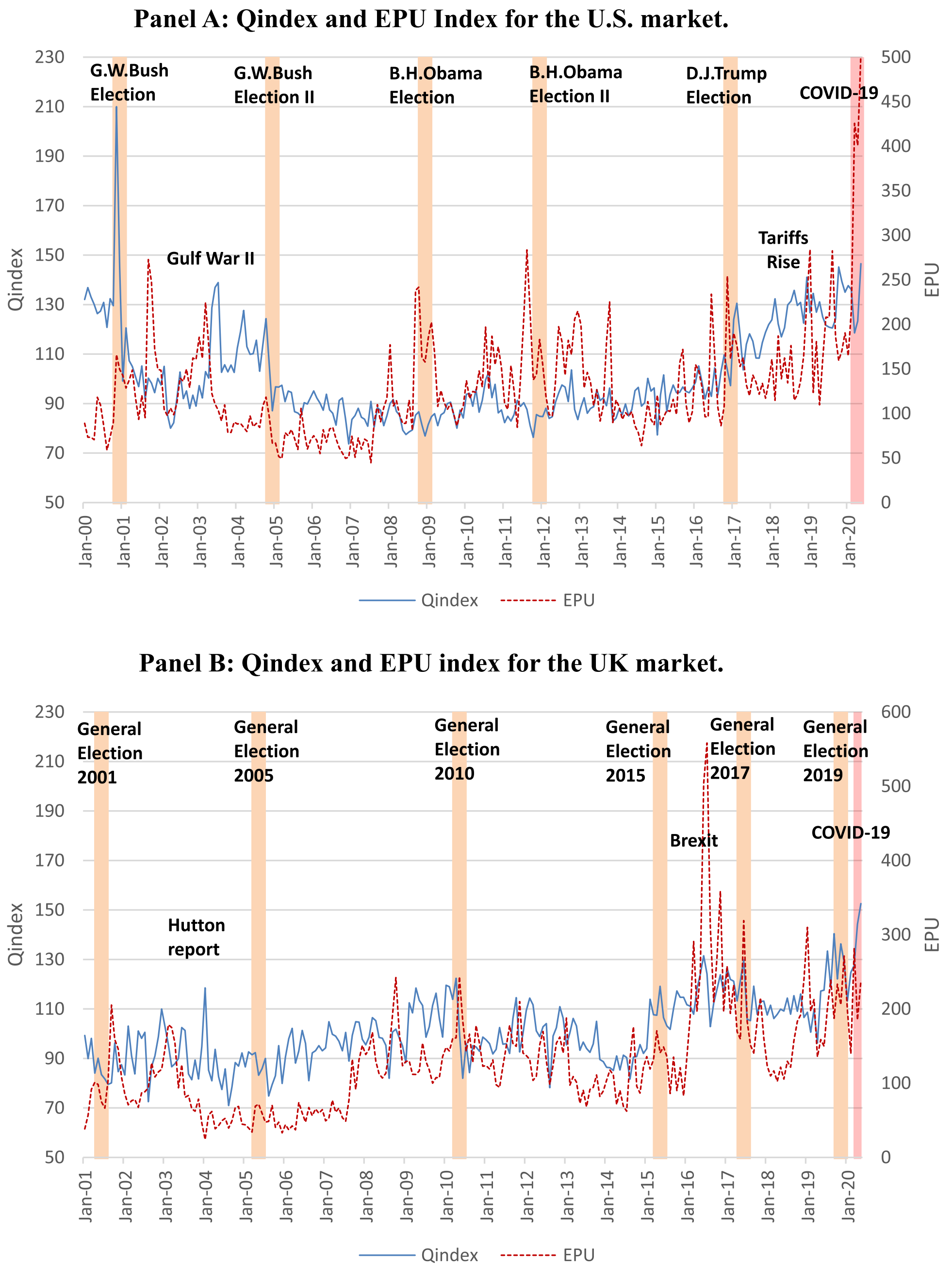

Fig. A.2. Quality of political signals versus economic policy uncertainty.
Fig. A.2, Panels A and B, show the co-movement between the EPU indices and *Qindices* for the United States over the period January 2000 to May 2020 and for the UK over the period January 2001 to May 2020, respectively.

Appendix B. Co-movement of the quality of political signal measures

Fig. B.1 depicts the co-movement between the U.S. *Qindex* and other proxies for the quality of political signals as an example. *WPFC_monthly* reported in Panel A is calculated as the sum of daily false claims in a given month reported by *The Washing Post* (available since Jan 2017).

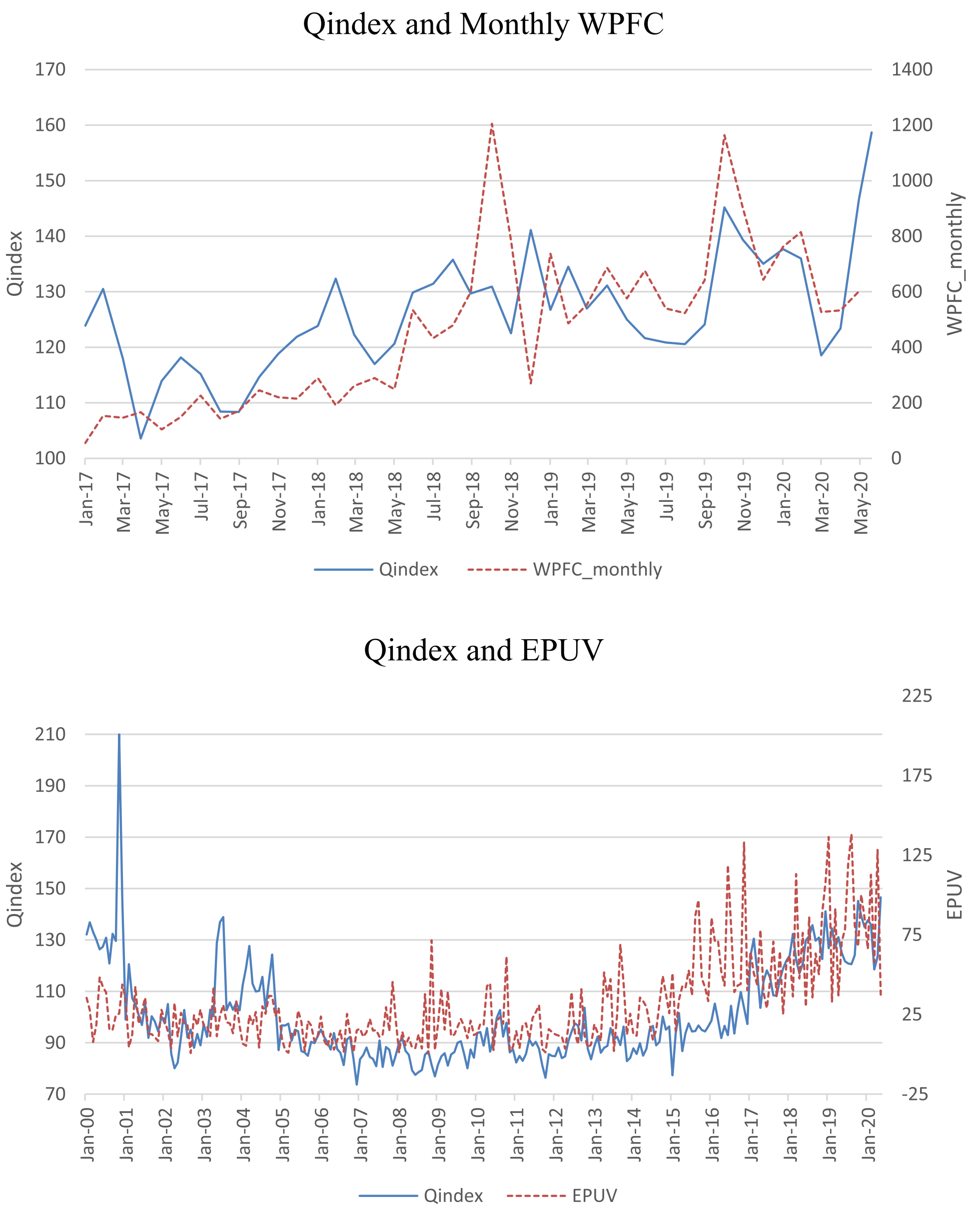

Fig. B.1.

Appendix C: Divergence between fear gauges and EPU indices in 2017

Table C.1
Analysis of the distribution of the VIX/VFTSE and EPU index.

Panel A: CBOE VIX, EPU, and S&P 500 Index in the U.S.												
VIX deciles (2000–2016)	1–10th	11–20th	21–30th	31–40th	41–50th	51–60th	61–70th	71–80th	81–90th	91–100th	2017	Mean of 2017 as percentile of 2000–2016
VIX	11.51	12.96	14.18	15.68	17.36	19.27	21.42	23.97	27.66	39.99	11.09	3rd
EPU index	76.02	101.84	109.62	108.76	113.38	117.81	122.20	128.07	138.59	176.70	142.69	74th
S&P500	1506.43	1645.29	1640.98	1496.51	1393.25	1334.27	1312.09	1265.49	1193.91	970.34	2449.08	Highest value
Observations	428	432	427	425	429	426	427	430	426	427	251	
Panel B: VFTSE, EPU, and FTSE 100 Index in the UK												
VTSE deciles (2001–2016)	1–10th	11–20th	21–30th	31–40th	41–50th	51–60th	61–70th	71–80th	81–90th	91–100th	2017	Mean of 2017 as percentile of 2001–2016
VFTSE	11.04	12.56	13.93	15.31	16.77	18.54	20.51	23.02	27.78	40.51	10.87	4th
EPU index	73.00	94.28	105.18	113.49	115.92	120.41	119.83	125.28	151.45	148.18	198.51	94th
FTSE100	5757.36	6116.47	5923.32	6023.13	5840.46	5637.62	5532.67	5385.67	5274.61	4304.26	7379.87	Highest value
Observations	403	404	402	402	403	403	403	402	403	402	252	

This table presents the means of the volatility index, news-based Baker-Bloom-Davis (BBD) EPU index, and equity market index based on the deciles of the volatility index for the U.S. over 2000–2017 in Panel A and the UK over 2001–2017 in Panel B. The last two columns present the mean of these indices in 2017 as well as the corresponding percentiles over periods before 2016.

Appendix D. The combined effects of factors on the relationship between UK EPU and VFTSE

	(1)	(2)	(3)	(4)	(5)	(6)
Qindex × Uncertainty (λ_5)	−0.2215***	−0.1256***	−0.1773***			
	(0.000)	(0.001)	(0.000)			
EPUV × Uncertainty (λ_5)				−0.0350***	−0.0232***	−0.0323***
				(0.000)	(0.000)	(0.000)
PC × Uncertainty (λ_6)	0.0743**	0.0673**	0.0803**	0.0728**	0.0625*	0.0769**
	(0.038)	(0.045)	(0.020)	(0.034)	(0.052)	(0.025)
CPM × Uncertainty (λ_7)	−0.0141***			−0.0174***		
	(0.000)			(0.000)		
PM × Uncertainty (λ_7)		−0.0269***			−0.0325***	
		(0.000)			(0.000)	
ES × Uncertainty (λ_7)			−1.3864*			−2.4249**
			(0.098)			(0.010)
Year Fixed Effect	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES
Adj.R-squared	0.862	0.869	0.874	0.864	0.869	0.874
N	4886	4886	4886	4886	4886	4886

This table reports the estimated slope coefficients from the following regression specifications as robustness tests for the UK market over the period January 2001 to May 2020:

$$\log(VFTSE_t) = \lambda_0 + \lambda_1 Uncertainty_t + \lambda_2 Quality_t + \lambda_3 Dispersion_t + \lambda_4 Bull\_spell_t + \lambda_5 Quality_t \cdot Uncertainty_t + \lambda_6 Dispersion_t \cdot Uncertainty_t + \lambda_7 Bull\_spell_t \cdot Uncertainty_t + \lambda_8 \cdot FTSE100_t + \lambda_9 Realized\_Volatility_t + \lambda_{10} Trend_t + \varepsilon_t$$

Each regression includes all three factor variables and their interaction terms with *Uncertainty*. The dependent variable is the log value of the VFTSE index; *Uncertainty* is the UK economic policy uncertainty index scaled by 100. We use two proxies for the quality of political signals $Quality_t$: the index constructed by us to measure the quality of political signals (*Qindex*) divided by 100; the absolute difference between monthly EPU and the average daily EPU within the month (*EPUV*) divided by 100. We use one proxy for investors' opinion divergence (*Dispersion*): the option volume deviation ratio (*PC*) calculated as |1-*P/C*|/(1 + *P/C*), where *P/C* is the put-call volume ratio of options traded on the CBOE exchange. We use three proxies for exceptional market performance $Bull\_spell_t$: the number of consecutive positive-return months of the FTSE 100 index (*CPM*); the number of positive-return months of FTSE 100 index in the last six months (*PM*); the 5% expected shortfall of the FTSE 100 index calculated as the average of the returns below the 5th percentile of daily returns in the past year (*ES*). Other controls include the log daily return of the FTSE 100 index, $\Delta FTSE100$; the logarithm value of one-month realized volatility of the FTSE 100 index, *Realized_Volatility*; the time trend variable, *Trend*. Newey-West standard errors with one lag are estimated and *p*-values are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Appendix E. Application of principal components of proxies for each factor

As part of our analysis, we consider the principal component analysis for each group of factors. We use the value of the first principal component as the proxy for each factor in our regression analysis (see table below). The results are consistent with our findings reported in Section 5. We also tested with the first principal component of the three *Quality* measures (*Qindex, EPUV, WPFC*) for the United States, and found consistent results.

Table E.1
Regression analysis with first principal components.

	U.S.				UK		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$COMP_{Quality} \times$ Uncertainty	−0.0310***			−0.0243***	−0.0250***		−0.0247***
	(0.000)			(0.000)	(0.000)		(0.000)
$COMP_{Dispersion} \times$ Uncertainty		0.0114**		0.0128***			0.0646*
		(0.031)		(0.009)			(0.053)
$COMP_{Bull\_spell} \times$ Uncertainty			−0.0580***	−0.0525***		−0.0334***	−0.0355***
			(0.000)	(0.000)		(0.000)	(0.000)
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj.R-squared	0.871	0.870	0.876	0.879	0.860	0.866	0.872
N	5100	5100	5100	5100	4886	4886	4886

This table presents the results of regression analysis with the first principal component of the proxies for each factor in the U.S. and the UK. The dependent variable is the logarithm of the implied volatility index (the VIX for the U.S. and the VFTSE for the UK); $COMP_{Quality}$ is the first principal component of the proxies of the quality of political signals (*Qindex, EPUV*) for the U.S. and the UK; $COMP_{Bull\_spell}$ is the first principal component of the proxies of bullish stock markets (*CPM, PM, ES*) for the U.S. and the UK; $COMP_{Dispersion}$ is the first principal component of the proxies of investors' opinion divergence (*PC, ISD, RSI*) only for the U.S.; since we only apply one measure of opinion divergence (*PC*) for the UK, $COMP_{Dispersion}$ in specification (7) is just the *PC* measure for the UK. Other control variables include the log daily return stock market index, the logarithm value of one-month realized volatility of the market index, and the time trend variable. Newey-West standard errors with one lag are estimated and p-values are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Appendix F. Robustness test with square terms

Panel A	U.S.			UK		
Quality of political signals	(1)	(2)	(3)	(4)	(5)	(6)
Qindex	0.9348***	−2.0809***	−0.3460***	0.7271***	−5.2251***	−0.5300**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.033)
Uncertainty	1.3108***	1.5823***	0.5141***	1.1487***	1.8267***	0.4156***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Qindex × Uncertainty	−0.9750***	−1.4977***	−0.2804***	−0.9104***	−1.6698***	−0.1775**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.016)
Square terms	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes
Panel B	U.S.			UK		
Opinion divergence	(1)	(2)	(3)	(4)	(5)	(6)
PC	0.5293***	−0.1234	−0.1928	−0.3700***	−0.0907	0.0290
	(0.000)	(0.682)	(0.119)	(0.000)	(0.511)	(0.654)
Uncertainty	0.2689***	0.3143***	0.2644***	0.0204	0.2674***	0.2703***
	(0.000)	(0.000)	(0.000)	(0.185)	(0.000)	(0.000)
PC × Uncertainty	0.3050**	0.4441***	0.1473*	0.3504***	0.1712**	0.0255
	(0.014)	(0.001)	(0.050)	(0.000)	(0.015)	(0.448)
Square terms	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes
Panel C	U.S.			UK		
Bullish market	(1)	(2)	(3)	(4)	(5)	(6)
CPM	0.0096	−0.0025	0.0285***	−0.0292***	−0.0939***	0.0143***
	(0.247)	(0.753)	(0.000)	(0.000)	(0.000)	(0.006)
Uncertainty	0.2969***	0.5673***	0.3168***	0.0996***	0.2948***	0.2935***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
CPM × Uncertainty	−0.0497***	−0.0827***	−0.0100**	−0.0234***	−0.0204***	−0.0112***
	(0.000)	(0.000)	(0.015)	(0.000)	(0.000)	(0.000)
Square terms	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes

This table presents the test results for basic specifications (together with/without square terms and controls) for the U.S. and the UK for our key set of variables representing the three theories. The table is divided into three panels showing the results for each theory. Square terms (i.e., $Uncertainty^2$ and the square of a given factor measure such as $Qindex^2$) are included in specifications (2), (3), (5), and (6). The dependent variable is the logarithm of the implied volatility index (the VIX for the U.S.; the VFTSE for the UK); control variables include the log daily return stock market index; the logarithm value of one-month realized volatility of market index, and the time trend variable. Newey-West standard errors with one lag are estimated and p-values are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

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