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Economic uncertainty: Mispricing and ambiguity premium

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Abstract

We uncover two channels of effect in the financial market when investors face macroeconomic uncertainty. Conditional on a common mispricing index, we find that economic uncertainty exposure (EUE) induces disagreement, which amplifies mispricing. The highest EUE quintile produces an annualised mispricing alpha of 9.96%, more than double the unconditional mispricing effect. An ambiguity premium of 3.84% alpha is documented in the "non-mispricing" quintile. The EUE-induced mispricing effect is different from the existing limits of arbitrage explanations. The ambiguity premium is predictably observed during the unfolding of shocks of COVID-19 to the market.

KEYWORDS

ambiguity aversion, cross-section of stock returns, economic uncertainty, mispricing, return predictability, risk premium

JEL CLASSIFICATION

G11, G12, E30, C13

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1 | INTRODUCTION

Macroeconomic uncertainty (MEU) has become an accustomed reality for policy, business and investment decision-makers. One recent and ongoing example is the heightened economic uncertainty caused by the COVID-19 pandemic. During this period, we have observed two phenomena in financial markets. First, the tug of war between optimists and pessimists in the market is intensified. This is exemplified by the record-breaking daily gains and losses closely clustered in the leading equity benchmark indices around the world.[1] Second, some investors prefer to watch from the sidelines by moving their money out of the equity market temporarily and looking for bargains for their long-term investments.[2] These phenomena aforementioned represent two different responses from investors to economic uncertainty. While both of these phenomena have been studied separately, existing studies have not been able to present a coherent framework to study both of these effects. This leads to inconclusive findings on the impact of MEU on asset pricing.

These two responses are broadly related to studies on how economic uncertainty affects investors' beliefs and preferences. First, MEU amplifies biases in individuals' beliefs by making optimists more optimistic and pessimists more pessimistic. Hirshleifer (2001) argues that uncertainty leaves more room for investors to follow their own subjective estimations and ignore objective valuations. Investors' heterogeneous beliefs about the fundamental value can be a source of mispricing (Hong & Stein, 2007). When there are contrasting beliefs among investors, Miller (1977) shows that stocks will be in general overpriced as this is more likely to reflect optimists' views than pessimists' in light of short-sale constraints. Therefore, these stocks will be more likely to experience overpricing and have *lower* expected returns. We refer to this effect as the mispricing effect of economic uncertainty, which amplifies the tension between optimists and pessimists.

Second, people prefer certain over uncertain outcomes. Uncertain outcomes have been classified into two groups by Knight (1921): one referred to as risk, which is defined as an event with a known distribution; and the other as uncertainty, which is an event with an unknown distribution. Knight (1921) contends that people are more averse to uncertainty than risk. In this regard, stocks' exposures to economic uncertainty will affect investors' preferences for these stocks. Anderson et al. (2009) show that macro uncertainty carries a positive premium in equilibrium in a dynamic model, and they find supportive empirical evidence using dispersion in the Survey of Professional Forecasters (SPFs) as a measure of uncertainty. In a nutshell, this line of literature predicts that investors would demand a premium from stocks with high exposure to economic uncertainty. We refer to this effect as the ambiguity-premium effect, and it applies to uncertainty-averse investors who would prefer to stay on the sidelines unless the expected compensation is high enough.

These two explanations regarding investors' behaviour in response to economic uncertainty have conflicting predictions on the relationship between firms' economic uncertainty exposure

[1]For example, in March 2020, the S&P 500 index experienced two of the top 20 historical best daily performances and three of the worst 20 daily performances since its introduction in 1923. In fact, two of these large episodes are next to each other: on March 12, 2020 with a return of −9.51% and March 13, 2020 with a return of 9.29%. See https://en.wikipedia.org/wiki/List_of_largest_daily_changes_in_the_S%26P_500_Index (accessed June 29, 2020). If we look at the oil price during the period, a similar extreme volatility can be observed.

[2]There is anecdotal evidence suggesting that investors first fall back to cash and move to safe assets, such as gold during this period. See https://www.cnbc.com/2020/04/20/coronavirus-why-gold-is-seen-as-a-safe-haven-investment-in-a-crisis.html?__source=newsletter%7Cmakeit (accessed June 29, 2020).

(EUE) and cross-sectional returns.[3] The ambiguity-premium effect predicts a positive correlation between EUE and expected returns, while the mispricing effect predicts a negative one. It is not surprising that existing studies provide mixed evidence on the relationship between EUE and expected returns.[4]

The challenge of obtaining a clear inference from the studies mentioned above is that both the ambiguity premium and mispricing mechanisms are at work. A clear conclusion can only be drawn when these two effects can be disentangled. The mispricing argument suggests that disagreement is a general source of mispricing (Hong & Stein, 2007). However, what information sources investors use to form their optimistic or pessimistic beliefs about the company are not specified in these models. It is, therefore, a useful identification strategy to study the effect of economic uncertainty when investors already have heterogeneous beliefs in the first place. To this end, the mispricing score (MIS) proposed by Stambaugh et al. (2012, 2015) using firm-level characteristics provides a measure of cross-sectional variation for overpricing and underpricing stocks.[5] If the disagreement is a source of mispricing, higher exposure to economic uncertainty will induce larger disagreement in investors' assessment of those firm-level value relevant characteristics and will lead to more apparent mispricing. In other words, high firm-level exposure to economic uncertainty will exacerbate investors' mispricing of other firm characteristics, making optimists more optimistic and pessimists more pessimistic. In addition, stocks in the non-mispricing group (neither overpriced nor underpriced) according to MIS can be used to study a "pure" ambiguity-premium effect since this subset of stocks is not influenced by these known mispricing characteristics.[6]

We develop the following two main hypotheses in Section 2: (1) If EUE-induced disagreement is a common source of mispricing, we expect that the mispricing effect (measured by the long–short portfolio sorted by MIS) will be the strongest in the group of stocks with the highest EUE; and (2) For stocks experiencing the least influence of mispricing measured by the MIS (i.e., those in the middle portfolio sorted by MIS), the ambiguity-premium effect of EUE will be the dominant effect, and therefore a positive relationship between EUE and expected return is expected.

In our empirical analysis, we measure EUE by estimating the absolute sensitivity of stock return to log changes of economic uncertainty proposed by Jurado et al. (2015, hereafter JLN).[7]

[3]We define EUE as the absolute sensitivity of the return to the log change of economic uncertainty. Empirically, it is estimated by the absolute value of the regression coefficient from a time series regression of a stock's returns on log changes of economic uncertainty index while controlling for other risk factors, such as Fama–French market factors. More detailed discussion can be found in Section 3.2.

[4]Li (2016) finds that stocks with higher exposures to macro-disagreement earn lower future returns, which provides support to the mispricing effect as proposed by Hong and Sraer (2016). Bali et al. (2017) also find a negative relationship between the uncertainty beta estimated using the uncertainty index in Jurado et al. (2015) and the expected return. These results are consistent with the mispricing argument under the hedging argument in the context of Merton's (1973) intertemporal capital asset pricing model (ICAPM). By contrast, Anderson et al. (2009) and Bali and Zhou (2016) provide evidence supporting a positive uncertainty premium. Brenner and Izhakian (2018) find that the ambiguity premium is positive when the expected probability of a positive outcome is high, while the ambiguity premium is negative when the expected probability of a negative outcome is high. The mixed findings in those studies may also be due to the use of different economic uncertainty proxies.

[5]Eleven firm characteristics are taken into account for MIS construction. Please see Section 3.1 for details.

[6]A similar approach is adopted by Stambaugh and Yuan (2017) when they construct their size factor using stocks least likely to be mispriced, that is, those in the middle mispricing group. They show that when controlling for the mispricing effect, a much clearer and strong size premium that is nearly twice that implied by the familiar Fama–French version of small-minus-big is documented.

[7]They define economic uncertainty as the conditional volatility of a disturbance that is unforecastable from the perspective of economic agents. They show that such a measure is better at capturing quantitively important uncertainty episodes than other popular financial market-based proxies, such as the volatility index.

We find supportive evidence for both mispricing and ambiguity-premium effects in the period between 1968 and 2020 in the US markets using a double-sorting portfolio-level analysis. First, the mispricing effect is the strongest in the group of stocks with the highest EUE, supporting our first hypothesis. The annualised mispricing alpha (i.e., the alpha of the portfolio that longs underpriced and shorts overpriced stocks) is 9.96% with a t statistic of 4.80 in the highest EUE quintile. This is more than double the unconditional mispricing effect without considering the effect of EUE (with an annualised alpha of 4.44%) in our sample.

Second, we identify a clear EUE ambiguity premium in the group of stocks that are the least affected by the mispricing index of Stambaugh et al. (2012). In this "non-mispricing" quintile group, alphas change from negative to positive as EUE increases from low to high, supporting our second hypothesis that ambiguity-averse investors would demand higher returns for stocks with higher EUE. The annualised alpha of the high-minus-low EUE portfolio within the "non-mispricing" quintile, measuring the EUE ambiguity premium, is 3.84% with a t statistic of 2.14.

Further insights into the effect of EUE on cross-sectional pricing can be gained by examining the asymmetric effect of EUE on over- and underpricing. We show that after controlling for the ambiguity-premium effect, overpricing is more prominently observed than underpricing due to short-sale constraints (Stambaugh et al., 2012).[8] This provides evidence supporting that disagreement and short-sale constraints induce more overpricing (Hong & Sraer, 2016). Furthermore, since overpricing is stronger than underpricing, the average mispricing effect is negative for all stocks. When we examine all stocks in the high EUE group without differentiating mispricing, the positive ambiguity premium and the negative mispricing effect almost cancel each other out, generating a close-to-zero alpha. This highlights the importance of disentangling the two-channel effects which were not observed in the existing literature. We confirm the robustness of our finding in Fama and MacBeth (1973) and double-cluster panel regressions on excess return with firm-level risk controls.

Section 5 provides further analysis to better understand these two channels. The COVID-19 pandemic provides us with a setting to conduct an "out-of-sample" analysis for our findings.[9] This unprecedented global health crisis had a huge effect on the global economy and financial markets (Goldstein et al., 2021). Cox et al. (2020) show that Federal Reserve's five "unconventional" policy announcements about new credit facilities collectively contributed to the shoring up risk tolerance as well as a stock market rebound in late March and April of 2020. Our additional analysis in Section 5.1 extends their findings by revealing how an ex ante estimate of economic uncertainty exposure can help predict stock market response to rises and falls of economic uncertainty during this period. Overall, the out-of-sample analysis of 2020 confirms that there is an ambiguity premium driven by economic uncertainty. Mispricing is amplified during this period with high economic uncertainty and the correction of the mispricing is yet to be seen.

To understand the marginal contribution of bringing EUE into the cross-sectional asset pricing, we further examine how two channels of the EUE effect are influenced by alternative risk models including a seven-factor model (FF's five factors, a momentum factor and an additional liquidity factor), q factor (Hou et al., 2015), q5 (Hou et al., 2021) and the mispricing

[8]To see a pure mispricing effect, we control for the ambiguity premium by removing the ambiguity premium from the over- and underpriced legs.

[9]The first draught of this paper was finished right at the beginning of the COVID crisis.

(Stambaugh & Yuan, 2017; hereafter MSP) models. In general, the influence of EUE on the identified mispricing anomalies is weakened as more elaborated multifactor models are used as benchmark models but remains significant in most of the models. By contrast, the ambiguity-premium effect of EUE remains strong with more elaborated risk models. In fact, the largest ambiguity premium comes from the q5 model, where the unconditional mispricing effect is fully explained. This demonstrates the robustness of the EUE ambiguity premium as a new factor that is different from existing risk factors and existing known mispricing.

Additionally, we study these two channels of effects with controls and interactions with well-known mispricing conditions, such as limits of arbitrage and investor sentiments. We confirm that exposure to economic uncertainty induces disagreement at the stock level. Furthermore, we find that the ambiguity-premium effect is strong in the group of stocks with low arbitrage friction, confirming that the ambiguity premium is not due to mispricing and it is consistent with the nature of the "risk" premium instead.

1.1 | Connection with the previous literature

We contribute to the literature by disentangling the ambiguity premium from the mispricing effect of economic uncertainty on cross-sectional asset pricing. Existing factor models (FF, q5, or MSP) are useful to predict expected cross-sectional returns regardless of whether they are rational compensation for systematic risk or reflect common sources of mispricing (Hirshleifer & Jiang, 2010; Kozak et al., 2018). We show that these two channels of effects need not be mutually exclusive. Exposure to MEU will not only amplify investors' biased beliefs, leading to stronger mispricing but also affect investors' preferences, producing an ambiguity premium. We provide evidence that links the aggregate disagreement to mispricing, supporting the theoretical proposition of Hong and Sraer (2016) and extending their work by identifying one common source of macro uncertainty that influences many different anomalies and also carries an observable "risk" premium.

Empirically we provide new evidence on economic uncertainty and asset pricing. Our study reconciles the seemingly contradicting findings of the coexistence of the positive and negative effects of EUE on expected stock returns when studied in isolation (see, e.g., Anderson et al., 2009; Bali & Zhou, 2016; Bali et al., 2017; Li, 2016). Similarly, Shen et al. (2017) do not find that macrofactor risk (not uncertainty) is priced cross-sectionally. This is because the relationship between asset return and exposure to macro-related factors is influenced by investor sentiment in a way that is consistent with Stambaugh et al. (2012). The "risk-premium" is only observed when there is low investor sentiment, whereas the exact opposite occurs following high-sentiment periods since the mispricing effect is dominant. However, none of the previous studies differentiates rational premium from mispricing empirically. We take one step further by decomposing these two channels of effects clearly and providing direct evidence on the difference between ambiguity premium and mispricing effect conditional on investor sentiments.

Brenner and Izhakian (2018) attribute observations of time-series variation in the ambiguity premium to the change of investors' attitudes toward ambiguity. Our cross-sectional analysis shows that this could be due to the asymmetric effect of ambiguity on mispricing. Controlling for mispricing, the ambiguity premium is positive. A positive ambiguity premium provides support to theoretical models (Anderson et al., 2009) and is consistent with the general view that people dislike uncertainty and should be compensated by a positive premium for bearing risk.[10]

Contributing to the mispricing literature, we show that EUE amplifies mispricing, especially following a high investor sentiment period. This identifies EUE as a common mispricing component across anomalies in the market, which is different from but complements investor sentiment and arbitrage risk (Nagel, 2005; Stambaugh et al., 2012, 2015). Furthermore from the limit of arbitrage point of view, Kozak et al. (2018) suggest that "sentiment-investor demand results in substantial mispricing only if arbitrageurs are exposed to factor risk when taking the other side of these trades." We provide direct evidence showing that the mispricing is worsening during the unfolding of COVID-19, suggesting that the economic uncertainty is a potential source of risk to arbitrage in this context.

Relatedly, our study also contributes to the growing literature on market reactions to a crisis, such as the 2008 financial crisis and COVID-19 crisis. Instead of focusing on event-specific mechanisms, such as corporate liquidity or differential impact of lockdown. Our research offers a general framework, ex ante, to understand how investors behave when facing a change of economic uncertainty. We show that holding securities with higher exposure to economic uncertainty will pay off handsomely when economic uncertainty is resolved while increasing economic uncertainty would deepen the mispricing. Importantly, our framework provides an identification strategy that can be estimated these expected responses based on historical data. It can be applied to understand the market responses to future changes of economic uncertainty.

Our findings have a direct implication for practical investment management. Our approach enables fund managers and investors to capture and report sources of alphas with improved clarity. Investors need to differentiate fund managers' skills from high returns generated by fund managers through exposure to common systematic factors (Song, 2020). Taking EUE into consideration in portfolio attribution analysis would enable investors to understand how economic uncertainty may affect the performance of a certain manager's strategy (e.g., those anomalies-/factors-driven strategies). Besides, given that EUE is new to the literature, investors may be able to identify the manager's "hidden" (alpha) skills that reflect the economic uncertainty-induced ambiguity premium. In other words, EUE can be part of a more advanced benchmark model for sophisticated investors to use in evaluating and selecting funds (Barber et al., 2016). In addition, our findings provide important insights for individual investors. It is important for them to recognise the potential mispricing effect during the high economic uncertainty period and to avoid making an investment decision that contributes to the mispricing and makes a negative expected return on average.

The rest of the paper is organised as follows. Section 2 reviews the literature and develops our main hypotheses. Section 3 presents our data. Section 4 presents the main findings. Section 5 reports robustness and further tests. Section 6 concludes.

[10]We consider the finding of the non-mispricing group as a risk premium rather than another mispricing factor for two reasons. First, as the COVID-19 case study in Section 5.1 shows that, stocks with high exposures to EUE experience significant negative returns, confirming the riskiness of such investment during that period. It then recovers when the economic uncertainty settles, earning the premium. Second, conditional tests with market-wide investor sentiment further confirm that it is not likely to be a mispricing phenomenon. Because other mispricing effects are found to be stronger following a high-sentiment period, while we find the opposite is true to this investment strategy.

2 | LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1 | Economic uncertainty measurement

The main difference between risk and uncertainty is related to the probability distribution of an event. Risk can be estimated and quantified with an objective distribution that all investors can use to make certain assumptions and predictions. However, uncertainty is unidentifiable and unmeasurable, thus those investors are unable to predict the likelihood of an event (Knight, 1921). Anderson et al. (2009) see uncertainty as investors' confidence in their estimation of the unknown mean and their errors in the approximation of a true conditional mean for the state variable.

JLN (2015) define uncertainty as the conditional volatility of the purely unforecastable component of the future value of the series. Therefore, uncertainty is about whether a state variable has become more or less predictable, that is less or more uncertain. An economic uncertainty index is then constructed as a weighted average of as many as 132 macroeconomic variables. This measure of the economic uncertainty index has two distinct advantages. First, it emphasises conditional volatility after removing all forecastable components, which makes it more in line with the theoretical definition of uncertainty instead of risk. Second, it has the advantage of capturing the uncertainty of the economy instead of the uncertainty of just one particular economic indicator by aggregating a large number of economic indicators. In our empirical study, we adopt this measure of economic uncertainty as our main measure.

2.2 | Economic uncertainty, disagreement and mispricing

Hong and Sraer (2016) link the market-wide uncertainty to the disagreement of firm value in a theoretical model. They show that macro uncertainty is important to belief formation, and the traditional CAPM beta also captures the degree of a stock exposure to market-wide uncertainty. A higher beta will lead to more disagreement in a stock value. Building on Miller (1977), this will lead to overpricing in the high beta stocks and hence explain the beta anomaly.[11] In this regard, their theory suggests that stocks with higher EUE will experience overpricing and have lower expected returns subsequently. Li (2016) tests Hong and Sraer's (2016) argument by focusing on disagreement measured by the exposure to a series of factor portfolios constructed by the SPFs database.[12] He finds supporting evidence that stocks with higher EUE earn lower returns only in the subperiod of high EU.

Many studies have shown that uncertainty at both the aggregate and firm levels causes disagreement (e.g., Anderson et al., 2009; Bachmann et al., 2013; D'Amico & Orphanides, 2008; Sadka & Scherbina, 2007). Hirshleifer (2001) argues that uncertainty leaves more room for

[11]Miller (1977) argues that asset prices are more likely to reflect the valuation made by optimists than pessimists when there is a high level of heterogeneous beliefs, resulting in overpricing and lower future return. The core of this argument is built on the fact that short-sale constraints make it more restricted and/or more costly for pessimists to express their opinions through their trading activities. An increase in heterogeneous beliefs will exacerbate this asymmetry and lead to more apparent overpricing. Strong support for this can be found in the literature subsequently (J. Chen et al., 2002; Diether et al., 2002).

[12]Li (2016) constructs macrofactors by measuring macro-disagreement on gross domestic product (GDP) growth, inflation rate, treasury bill rate, industrial production (INPR) and nonresidential fixed investment (RNRSN) from the SPFs database.

investors to follow their own subjective estimations and ignore objective valuations, and therefore reduces the quality of information used in stock valuation. Harrison and Kreps (1978) and Scheinkman and Xiong (2003) argue that in a dynamic setting, stocks with more investors' disagreement will have higher price/earnings ratios and lower subsequent returns. In other words, higher exposure to uncertainty would amplify the value effect. Bali and Zhou (2016) show that incorporating the uncertainty beta provides both statistical and economic success in explaining some stock market anomalies (Small–Big for the size anomaly, Value–Growth for the book-to-market anomaly and HiTech–Telcm for the industry anomaly). This line of the literature suggests that exposure to economic uncertainty can lead to overpricing and also be a common factor affecting existing mispricing anomalies.

We hypothesise that higher exposures to economic uncertainty will exacerbate investors' disagreement about those valuation characteristics used to construct MIS and lead to stronger heterogeneous beliefs about the stock value. One possible reason is that investors become overconfident with their private information (Hirshleifer, 2001). Stronger disagreement would further lead to more apparent mispricing. Therefore, our first hypothesis is as below:

H1 *Mispricing spreads, sorted by MIS, are larger among stocks with higher EUE relative to those with lower EUE.*

We refer to this effect as the mispricing effect of EUE.

2.3 | Economic uncertainty and ambiguity premium

When facing uncertainty, investors seem to expect the worst situation (Anderson et al., 2003). Maenhout (2004) shows that if investors are concerned that their model of stock returns is misspecified, they will charge a substantially higher equity premium as compensation for the perceived ambiguity in the probability distribution. Heath and Tversky (1991) argue that ambiguity aversion has much to do with how competent an individual feels when assessing the relevant distribution. For example, Warren Buffett steered clear of dotcom stocks, even during the height of the tech boom in the late 1990s, and he is also reluctant to invest in technology companies because he is not confident in estimating their values.[13] In short, uncertainty will alter investors' preferences.

Among studies on economic uncertainty, Anderson et al. (2009) show that securities that are positively correlated with their MEU measures have higher expected returns, implying that uncertainty-averse investors demand higher returns as compensation. Bali and Zhou (2016) provide further support for this conjecture, showing that equity portfolios that are highly correlated with variance risk premium (VRP, a proxy for financial and economic uncertainty) carry a significant premium relative to those that are uncorrelated or minimally correlated with VRP. In general, this line of research proposes a positive risk premium effect of a stock's exposure to economic uncertainty.[14]

[13]https://www.forbes.com/sites/simonmoore/2019/05/05/buffetts-relationship-with-tech-stocks-its-complicated/#31f3a5dc63da (accessed June 29, 2020).

[14]There is another stream of literature studying the uncertainty premium based on the ICAPM (Merton, 1973) (see, e.g., Bali et al., 2017; Ozoguz, 2008). They show that there is a positive uncertainty premium. The theoretical argument is similar to those discussed above, and it suggests that for risk-averse investors assets that covary positively with future investment opportunities have higher average returns. Different from the traditional risk-sharing literature, they focus on the directional

We refer to this effect as the ambiguity-premium effect of economic uncertainty. Therefore, our second hypothesis is as below:

H2 *There is a positive relationship between EUE and future returns for stocks in the non-mispricing group which is the least influenced by mispricing captured by MIS.*

It is important to note that our ambiguity-premium hypothesis is conditional on removing the general mispricing effect. Stambaugh et al. (2015) show that the asymmetric effect of idiosyncratic volatility (IVOL) on the different mispricing legs leads to inconclusive empirical relationships observed between IVOL and expected return. In a similar vein, our hypotheses developed above suggest that the asymmetric effect of EUE on different mispricing legs will affect the conclusion of the pure EUE risk premium effect. Particularly, for stocks with higher EUE, the positive EUE risk premium is more apparent in the underpriced leg (with higher expected returns) since both the risk premium and the mispricing effects work in the same direction. By contrast, in the overpriced leg, the positive effect of the ambiguity premium will be offset by the negative expected return due to the mispricing effect. Therefore, we expect that the ambiguity-premium effect will be more clearly captured by a group of stocks that are less affected by mispricing. To this end, the middle quintile sorted on mispricing would be a good candidate portfolio as "orthogonal" to mispricing (neither over- nor underpriced with respect to those firm characteristics). The variation of EUE and expected return in this group of stocks captures a "purer" ambiguity-premium effect compared with other mispricing groups. Similarly, we expect that the "pure" mispricing effect in the over- and underpriced legs can only be observed when the positive ambiguity-premium effect is properly controlled (see more discussion on this in Section 4.2).

3 | DATA AND MEASURES

The data set used in our empirical analyses contains all common stocks (with share codes of 10 and 11) on the NYSE, AMEX and NASDAQ (with exchange codes of 1, 2 and 3). Stocks whose prices are less than $5 per share and market capitalisation below the fifth percentile breakpoint of NYSE market capitalisation are excluded from the sample since those assets are hard to short (Asquith et al., 2005).[15] Monthly asset returns are from Center of Research in Security Prices (CRSP) and companies' fundamental values are from the merged CRSP-Compustat database from July 1963 to December 2020. To calculate monthly analyst forecast dispersion, data on analysts' earnings estimates are from the unadjusted I/B/E/S starting from December 1981.

correlation for hedging purpose argument. In other words, they propose that assets that have a negative correlation with uncertainty have higher "uncertainty risk." These stocks should carry a premium. Such an argument relies on investors being able to predict the future state (the unexpected changes in uncertainty in this case). However, the challenge of this argument is that investors are not able to predict future economic uncertainty, therefore arguing that they will take a directional hedging position against the foundation for the discussion of uncertainty. For this reason, our discussion focuses on the absolute level of exposure to economic uncertainty, avoiding the directional interpretation. Empirically we measure the exposure by the absolute value of the beta coefficients. In a robustness test, we also show the results obtained without taking the absolute value of MEU beta. It confirms that there is no obvious asymmetry in the results for positive and negative beta and taking the absolute value of the exposure beta presents a consistent and simplified interpretation of the empirical findings. See Table OA.1 in the Supporting Information for more details.

[15] NYSE market capitalisation breakpoints are from Kenneth French's website: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html (accessed in July 2021).

3.1 | Mispricing measure

Following Stambaugh et al. (2015), the mispricing measure (MIS) is constructed based on 11 market anomalies. Their detailed definitions can be found in Appendix A. Stocks with the highest MIS scores are assigned as the most overpriced, while those with the lowest MIS scores are assigned as the most underpriced. Stambaugh et al. (2015) show that MIS minimises noisy measures of anomaly-specific effects. Thus, we have a single factor in identifying the degree of mispricing more accurately in the market. Additionally, they find that long–short portfolios formed on MIS have a higher average return relative to individual-anomaly portfolios, indicating that the new MIS measure is better at identifying mispricing in the market.[16]

3.2 | Economic uncertainty exposure

The main economic uncertainty index used in our analysis is proposed by JLN. This index is constructed based on 132 microseries, not on any single (or a small number of) economic indicators, measuring uncertainty in the whole economy. JLN show that using this measure can capture uncertainty in different macro variables at the same time across companies, industries, markets and regions. Kozeniauskas et al. (2018) study the relationship among existing economic uncertainty measures. They show that different measures are potentially capturing three different causes driving economic agents to become uncertain. Nevertheless, among the measures, the JLN measures have the highest overall correlation with other measures. We also study the effect of other uncertainty measures in Section 5.3. Corresponding results highlight the advantage of using the JLN economic uncertainty index.

JLN provide the measure for three forecasting horizons (1-, 3- and 12-month ahead). In this paper, we use the 1-month ahead economic uncertainty index, which is compatible with our monthly rebalancing analyses.[17] The index is obtained from Sydney Ludvigson's website.[18]

To measure innovations in economic uncertainty, we use monthly logarithmic changes in the index (ΔUNC_t).[19]

$$\Delta UNC_t = ln\left(\frac{UNC_t}{UNC_{t\text{-}1}}\right). \tag{1}$$

[16]Monthly MISs for each stock from July 1965 to December 2016 are collected from Robert F. Stambaugh's website and we updated them to December 2020. See more details related to MIS formation at http://finance.wharton.upenn.edu/%7Estambaug/ (accessed in July 2021).

[17]Using the 3- and 12-month forecasts will produce a similar conclusion except for a weaker effect in the ambiguity channel as reported in Table OA.2 of the Supporting Information. This potentially reflects the decay in the quality of the longer horizon EUE forecast and the incompatibility of the forecasting horizon and the rebalancing frequency.

[18]https://www.sydneyludvigson.com/data-and-appendixes/ (accessed in July 2021).

[19]Unexpected innovations in macroeconomic variables concern investors about their future investment and consumption, influencing the indirect utility of real wealth and asset prices. Thus, using the changes in economic uncertainty is consistent with the literature (e.g., Bali et al., 2021; N. F. Chen et al., 1986; Merton, 1973; Ross, 1976). The level of the index is nonstationary with a Dickey–Fuller statistic of −2.152, while its logarithmic difference is stationary with a Dickey–Fuller statistic of −13.678.

We estimate the uncertainty beta from the following model using previous 60-month observations on a rolling basis:[20]

$$R_{i,t} = \alpha_{i,1} + \beta_{i,1}\Delta UNC_t + \beta_{i,2}MKT_t + \beta_{i,3}SMB_t + \beta_{i,4}HML_t + \beta_{i,5}UMD_t + \beta_{i,6}IA_t + \beta_{i,7} ROE_t + \varepsilon_{i,t}, \quad (2)$$

where $R_{i,t}$ is the monthly excess return of stock i in month t. ΔUNC_t is a proxy for innovations in economic uncertainty in month t. MKT_t, SMB_t, HML_t, UMD_t, IA_t and ROE_t are Fama and French factors in month t. Definitions are given in Appendix A. These factors are from Kenneth French's website.[21]

Once we have estimated the monthly MEU beta for each stock during the sample period, we use the absolute value of MEU betas for all analyses in this study. This approach is consistent with relevant studies (Hong & Sraer, 2016; Li, 2016). In Hong and Sraer's (2016) prediction, aggregate disagreement is positively associated with the absolute value of market beta.[22] This is because disagreement is higher for stock returns that are highly correlated with uncertainty regardless of the positive or negative sign. The use of the absolute value also matches our intention to examine the impact of MEU on the uncertainty of a stock's return distribution (the variance of the distribution). A large magnitude of the beta, no matter whether it is positive or negative, makes the variance of the return more sensitive to the change in economic uncertainty.[23]

4 | EMPIRICAL ANALYSES

4.1 | Economic uncertainty exposure and mispricing index

We employ bivariate portfolio analyses to examine the relation between EUE and cross-sectional expected returns conditional on the general mispricing of stocks. Following Stambaugh et al. (2015), at the end of each month t, five portfolios are formed by sorting individual stocks' EUE estimated in Equation (2) up to month t. Then, independently another five portfolios are constructed by sorting on stocks' MIS in month t. Finally, 25 EUE–MIS portfolios are formed as intersections of five EUE and five MIS groups, and value-weighted returns are calculated during month $t + 1$. The first set of the 25 portfolios is formed in July 1968.

Before examining portfolio returns, we study the distribution of EUE among these portfolios. Table 1 reports the average EUE (in Panel A) and the number of stocks (in Panel B) in 25 portfolios. Panel A shows that overpriced stocks (the Overpriced row) have higher EUE

[20]We require at least 24 monthly observations for each stock to estimate the model. A rolling window for beta estimation enables us to obtain a time-varying exposure available at the time of the portfolio rebalance (see, e.g., Bali et al., 2017; Bali et al., 2021; Li, 2016).

[21]http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html (accessed in July 2021).

[22]In the Supporting Information Table OA.1, we also report results obtained without taking the absolute value of the MEU beta. We show that there is no obvious asymmetry in findings for stocks with positive and negative MEU betas. Grouping stocks by their absolute MEU betas improves the clarity of the interpretation and a consistent connection to the theoretical argument.

[23]We examine correlations between the log change of economic uncertainty and the other risk factors in Table OA.3 of the Supporting Information. The correlations are very low with a maximum of −0.148 for the correlation with the market factor.

TABLE 1 Economic uncertainty exposure of the 25 EUE–MIS portfolios

This table reports the average EUE coefficients and the number of stocks of the 25 EUE–MIS portfolios in Panels A and B, respectively. The EUE is the absolute beta coefficient of ΔUNC from the following regression with 5-year rolling data for each stock: $R_{i,t} = \alpha_{i,1} + \beta_{i,1}\Delta UNC_t + \beta_{i,2}MKT_t + \beta_{i,3}SMB_t + \beta_{i,4}HML_t + \beta_{i,5}UMD_t + \beta_{i,6}IA_t + \beta_{i,7}ROE_t + \varepsilon_{i,t}$, where $R_{i,t}$ is the monthly excess return of stock i in month t. ΔUNC_t is a proxy for innovations in economic uncertainty in month t. MKT_t, SMB_t, HML_t, UMD_t, IA_t and ROE_t are Fama and French risk factors in month t. Variable definitions are listed in Appendix A. The pooled average of stocks in each portfolio over the sample period is reported. The sample period is from July 1968 to December 2020.

	Low EUE	2	3	4	High EUE	All stocks
Panel A: Average EUE						
1 Overpriced	0.136	0.259	0.439	0.722	1.733	0.658
2	0.123	0.250	0.435	0.716	1.603	0.625
3 Non-mispricing	0.118	0.247	0.431	0.715	1.529	0.608
4	0.114	0.245	0.430	0.712	1.487	0.598
5 Underpriced	0.113	0.244	0.429	0.711	1.454	0.590
All stocks	0.121	0.249	0.433	0.715	1.561	
Panel B: Average number of stocks						
1 Overpriced	73	75	79	89	125	442
2	88	88	89	92	97	454
3 Non-mispricing	95	95	93	91	83	457
4	98	99	97	91	75	460
5 Underpriced	101	100	97	91	69	459
All stocks	456	456	456	454	450	

Abbreviations: EUE, economic uncertainty exposure; MIS, mispricing score.

compared with underpriced ones (the Underpriced row). The averages of EUE for five MIS portfolios monotonically decrease from 0.658 for the overpriced group to 0.590 for the underpriced group. This pattern holds in all subgroups with varying EUE.

Furthermore, examining the number of stocks in the portfolio shows that the overpriced high EUE portfolio has the highest number of stocks (125) among the 25 portfolios. It confirms that among overpriced stocks (the Overpriced row), more of them have a higher EUE; and among stocks with high EUE (the high EUE column), more of them are overpriced rather than underpriced.[24] Given that we use independent sorting, the distribution of stocks suggests a strong association between overpricing and high EUE. It supports our hypothesis that EUE could be a common determinant of mispricing.

[24]There are on average 2272 stocks in each month in our sample, which is comparable to previous studies. For instance, Stambaugh et al. (2015) report 3113 stocks in each month on average, while this figure is 2414 in Liu et al. (2018).

4.2 | Economic uncertainty exposure and cross-sectional return: Bivariate sort

We next examine the risk-adjusted returns of these 25 value-weighted portfolios.[25] Those portfolios are rebalanced at the end of each month during the sample period. The risk-adjusted returns are alphas estimated by the following augmented Fama and French (2016) six-factor model:

$$R_{p,t} = \alpha_{p,1} + \beta_{p,1}MKT_t + \beta_{p,2}SMB_t + \beta_{p,3}HML_t + \beta_{p,4}UMD_t + \beta_{p,5}IA_t + \beta_{p,6}ROE_t + \varepsilon_{i,t}, \quad (3)$$

where $R_{p,t}$ is the excess return of portfolio p in month t and $\alpha_{p,1}$ is adjusted return. MKT_t, SMB_t, HML_t, UMD_t, IA_t and ROE_t are Fama and French factors in month t. Finally, t statistics are reported in parentheses using Newey and West (1987) robust standard errors. The results of the portfolio analyses are presented in Table 2.

Panel A of Table 2 reports the alphas for the 25 EUE–MIS portfolios. We also report risk-adjusted returns on average and univariate sorted portfolios for MIS (the last two columns) and EUE (the last two rows), respectively. We refer to the spread returns in the univariate sorted portfolios as measuring the unconditional MIS and unconditional EUE effects. Panel A of Table 2 confirms that there is significant unconditional mispricing. The alpha of the long–short portfolio is 0.37% per month with a t statistic of 4.01, as shown in the univariate MIS column. However, the unconditional EUE effect on cross-sectional return is statistically insignificant as reported in the univariate EUE row. As we examine in the following analyses, this insignificant effect is due to the negative mispricing effect and the positive ambiguity-premium effect of EUE cancelling each other out.

Turning our attention to the 25 double-sorted portfolios, we show that mispricing alphas are significant in four of the EUE quintiles and the mispricing effects (in the Underpriced–Overpriced row) are increasing from the low to high EUE groups in general. Specifically, we observe the strongest mispricing in the high EUE quintile with an alpha of 0.83% per month (9.96% per annum, with a t statistic of 4.80). This is more than double the unconditional mispricing alpha (0.37% per month). These findings show that stocks with higher EUE experience stronger mispricing in the market, supporting our first hypothesis.

Examining the EUE effect in the middle quintile of the mispricing (the "3 Non-mispricing" row of Panel A of Table 2), the high–low EUE portfolio generates a significant alpha of 0.32% per month (3.84% per annum) with a t statistic of 2.14. It confirms that exposure to MEU is priced in non-mispricing portfolios. This finding provides evidence for the existence of the ambiguity premium, which is different from those mispricing factors and known risk factors, supporting our second hypothesis.

Traditionally, overpricing is more prominently observed than underpricing due to short-sale constraints (Stambaugh et al., 2012). When studying the return in the 25 portfolios, these returns are not only reflecting the mispricing effect. They would also capture the ambiguity-premium effect. In other words, stocks with a high level of EUE would have a positive ambiguity premium attached to them. This applies to not only the non-mispricing group, but also all other stocks regardless of their mispricing status. To see a pure mispricing effect, we control for the ambiguity premium by longing the overpriced (or underpriced) leg and shorting the corresponding middle "non-mispricing" group for each of the EUE quintiles. Intuitively, the ambiguity premium recorded by the non-mispricing

[25]Analyses of excess returns (return minus risk-free rate) of these portfolios can be found in Table OA.4 of the Supporting Information. The results are consistent with the main findings.

TABLE 2 Risk-adjusted returns of 25 portfolios double-sorted by EUE and MIS

This table reports the risk-adjusted returns on five MIS (EUE) and 25 EUE–MIS value-weighted portfolios in Panel A. The 25 portfolios are formed by independently sorting on EUE and the mispricing scores. The mean of five MIS (EUE) portfolios is reported in the Average MIS (EUE) column (row). The five MIS (EUE) portfolios are formed by sorting individual stocks on their mispricing scores (EUE), reported in the univariate MIS (EUE) column (row). Panel B reports the ambiguity-premium adjusted returns on the difference between each double-sort portfolio and the corresponding value in the middle mispricing quintile called "non-mispricing" group. The risk-adjusted returns are estimates of alphas estimated by the following model: $R_{p,t} = \alpha_{p,1} + \beta_{p,1}MKT_t + \beta_{p,2}SMB_t + \beta_{p,3}HML_t + \beta_{p,4}UMD_t + \beta_{p,5}IA_t + \beta_{p,6}ROE_t + \varepsilon_{i,t}$, where $R_{p,t}$ is the excess return of portfolio p in month t and $\alpha_{p,1}$ is adjusted return in percent. MKT_t, SMB_t, HML_t, UMD_t, IA_t and ROE_t are Fama and French market factors in month t. Variable definitions are listed in Appendix A. Portfolio returns are in percent and t statistics are reported in parentheses using Newey and West (1987) robust standard errors with three lags. The sample period is from July 1968 to December 2020. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	Low EUE	2	3	4	High EUE	High–low	Average MIS	Univariate MIS
Panel A: Mispricing alphas								
1 Overpriced	−0.24**	−0.03	−0.49***	−0.37***	−0.47***	−0.22	−0.32***	−0.31***
	(−2.34)	(−0.32)	(−3.70)	(−3.19)	(−4.03)	(−1.47)	(−4.60)	(−4.30)
2	−0.03	−0.02	0.00	−0.03	0.07	0.10	0.00	−0.01
	(−0.28)	(−0.15)	(0.03)	(−0.30)	(0.55)	(0.60)	(0.01)	(−0.32)
3 Non-mispricing	−0.12	0.04	−0.06	0.04	0.19	0.32**	0.02	−0.02
	(−1.48)	(0.42)	(−0.88)	(0.42)	(1.50)	(2.14)	(0.42)	(−0.51)
4	0.09	−0.07	−0.00	0.02	0.11	0.02	0.03	0.01
	(1.21)	(−1.00)	(−0.03)	(0.20)	(0.71)	(0.13)	(0.62)	(0.19)
5 Underpriced	0.04	0.07	0.01	0.14	0.36***	0.32**	0.13***	0.06
	(0.56)	(1.19)	(0.21)	(1.48)	(2.73)	(2.14)	(3.02)	(1.59)
Underpriced−Overpriced	0.28**	0.11	0.51***	0.50***	0.83***	0.54***	0.45***	0.37***
	(2.23)	(0.81)	(3.13)	(3.52)	(4.80)	(2.71)	(4.89)	(4.01)
Average EUE	−0.05	−0.00	−0.11***	−0.04	0.06	0.11		
	(−1.29)	(−0.03)	(−2.61)	(−0.80)	(0.71)	(1.12)		

(Continues)

TABLE 2 (Continued)

	Low EUE	2	3	4	High EUE	High–low	Average MIS	Univariate MIS
Univariate EUE	0.01	0.05	−0.06	0.01	0.10	0.09		
	(0.24)	(1.24)	(−1.43)	(0.29)	(1.20)	(0.87)		
Panel B: Ambiguity-premium adjusted alphas								
1 Overpriced	−0.12	−0.08	−0.43***	−0.41***	−0.66***	−0.54***		
	(−0.94)	(−0.53)	(−2.86)	(−2.66)	(−4.03)	(−2.93)		
2	0.10	−0.06	0.07	−0.08	−0.12	−0.22		
	(0.85)	(−0.53)	(0.63)	(−0.53)	(−0.86)	(−1.22)		
3 Non-mispricing	0.00	0.00	0.00	0.00	0.00	0.00		
4	0.21*	−0.12	0.06	−0.03	−0.08	−0.29		
	(1.84)	(−1.02)	(0.62)	(−0.18)	(−0.53)	(−1.56)		
5 Underpriced	0.16	0.03	0.08	0.09	0.17	0.01		
	(1.48)	(0.23)	(0.80)	(0.64)	(0.97)	(0.04)		
Underpriced−Overpriced	0.28**	0.11	0.51***	0.50***	0.83***	0.54***		
	(2.23)	(0.81)	(3.13)	(3.52)	(4.80)	(2.71)		

Abbreviations: EUE, economic uncertainty exposure; MIS, mispricing score.

group would also be applied to all stocks with the same level of EUE quintile. As expected, Panel B of Table 2 shows that, after removing the ambiguity-premium effect, overpricing is much more prominent than underpricing. Alphas of overpriced portfolios become more negative as EUE increases from low to high, confirming the amplification effect of EUE on overpricing stocks. By contrast, there is no evidence of the EUE effect on the underpriced leg. This evidence provides further support to our first hypothesis that disagreement and short-sale constraints contribute to overpricing not underpricing and this is consistent with the model of Hong and Sraer (2016).

Overall, our results document that EUE has two effects on cross-sectional asset pricing. There is significant and economically large mispricing among stocks with high EUE and a positive risk premium effect in the non-mispricing group. The mispricing effect is more apparent among overpriced stocks, which produces a negative effect on stock returns. When considering the overall EUE effect on the high EUE stocks, this negative mispricing effect cancels out the positive risk premium effect, and we cannot observe a clear EUE effect on the cross-sectional returns. These findings demonstrate the importance of disentangling the two channels of effect to understand the economic impact of EUE on asset pricing, which has been overlooked in the literature.

4.3 | Economic uncertainty exposure and cross-sectional return: Regressions

In Section 4.2, we study the risk-adjusted returns for bivariate-sorted portfolios. The results are intuitive and practically relevant to investment return from the factor investing point of view. In this section, we examine our hypotheses at a stock level using the Fama and MacBeth (1973) cross-sectional regressions. Petersen (2009) shows that the Fama–MacBeth procedure gives downward-biased standard errors despite Newey and West (1987) adjustment used in estimations.[26] Therefore, we also employ a series of panel regressions for double-clustered standard errors at the firm and year levels. We test the effect of firm-level EUE exposure on monthly excess returns by the following model:

$$Y_{p,t+1} = \lambda_{0,t-1} + \lambda_1 EUE_{p,t} + \lambda_2 MIS_{p,t} + \lambda_3 MIS * EUE_{p,t} + \sum_{J=4}^{n} \lambda_j X_{p,t} + Fixed\ Effects + \varepsilon_{i,t}, \tag{4}$$

where $Y_{p,t+1}$ is the excess return for stock p in month $t+1$. $X_{p,t}$ is a set of stock-specific variables in month t for stock p, including β^{CAPM}, $DISP$, $IVOL$, TO, $SIZE$, MOM, REV, BM, $ILLIQ$, ROE, and I/A. All variables are defined in Appendix A. In Fama–MacBeth regressions, we control for industry-fixed effect and standard errors are robust using Newey and West (1987) with three lags. In panel regressions, firm/industry and year fixed effects are included, and standard errors are double-clustered at the firm/industry and year levels (Cameron et al., 2011). We report regression results in Table 3.

Panel A reports the Fama–MacBeth regressions with industry-fixed effect. It shows that, without controlling for other factors, EUE is negatively correlated with the next period's return cross-sectionally. Controlling for the mispricing index does not change the sign of the EUE predictability.

[26]For more details and extensive literature re-examined and compared using different estimation methods, see Petersen (2009).

TABLE 3 Fama–MacBeth and panel regressions of excess returns

This table reports Fama–MacBeth cross-sectional and panel predictive regressions of monthly excess returns using the following model: $Y_{p,t+1} = \lambda_{0,t} + \lambda_1 EUE_{p,t} + \lambda_2 MIS_{p,t} + \lambda_3 MIS * EUE_{p,t} + \sum_{J=4}^{n} \lambda_j X_{p,t} + Fixed\ \ Effects + \varepsilon_{i,t}$,where $Y_{p,t+1}$ is the excess return for stock p in month $t+1$. $X_{p,t}$ is a set of stock-specific variables in month t for stock p, including β^{CAPM}, *DISP, IVOL, TO, SIZE, MOM, REV, COSKEW, MAX, BM, ILLIQ, ROE* and *I/A*. Variable definitions are listed in Appendix A. In Fama–MacBeth regressions (Panel A), industry-fixed effect is included and standard errors are robust using Newey and West (1987) with three lags. In panel regressions (Panel B), firm/industry and year fixed effects are included and standard errors are double-clustered at the firm and the year levels. The slope coefficients are in percent and t statistics are reported in parentheses. The sample period for the full specification is from December 1981 to December 2020, due to *DISP* availability. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	1	2	3	4
Panel A: Fama–MacBeth regressions				
EUE	−0.201***	−0.098**	0.356***	0.455***
	(−3.83)	(−2.13)	(2.95)	(2.80)
MIS		−0.025***	−0.019***	−0.005
		(−7.69)	(−5.62)	(−1.58)
*EUE * MIS*			−0.008***	−0.009***
			(−4.41)	(−2.92)
β^{CAPM}				0.148
				(1.35)
DISP				−0.033
				(−0.56)
IVOL				22.693***
				(4.22)
TO				0.010
				(0.32)

TABLE 3 (Continued)

	1	2	3	4
SIZE				−0.000**
				(−2.12)
MOM				0.404***
				(2.77)
REV				−0.541
				(−1.59)
COSKEW				0.060
				(0.89)
MAX				−28.483***
				(−7.03)
BM				−0.003
				(−0.03)
ILLIQ				−4.491
				(−0.46)
ROE				0.652**
				(2.09)
I/A				−0.214***
				(−3.71)
Constant	0.747***	1.993***	1.689***	1.233***
	(3.25)	(11.84)	(10.94)	(6.32)
Observations	1,525,341	1,431,635	1,431,635	625,651

(Continues)

TABLE 3 (Continued)

	1	2	3	4
R^2	0.057	0.065	0.066	0.141
Adjusted R^2	0.052	0.060	0.060	0.121
Firm FE	N/A	N/A	N/A	N/A
Industry FE	Yes	Yes	Yes	Yes
Year FE	N/A	N/A	N/A	N/A
Cluster by firm	N/A	N/A	N/A	N/A
Cluster by year	Yes	Yes	Yes	Yes

	5		6		7		8	
Panel B: Panel regressions								
EUE	−0.003	−0.199	0.026	−0.133	0.416***	0.538***	0.634***	0.630***
	(−0.039)	(−1.645)	(0.364)	(−1.090)	(2.709)	(3.585)	(2.778)	(3.100)
MIS			−0.021***	−0.029***	−0.016***	−0.020***	−0.007	−0.017***
			(−4.053)	(−6.284)	(−2.979)	(−4.372)	(−1.124)	(−3.394)
EUE * *MIS*					−0.007***	−0.012***	−0.009**	−0.013***
					(−3.100)	(−6.448)	(−2.574)	(−3.200)
β^{CAPM}							−0.092	−0.101
							(−0.428)	(−0.742)
DISP							0.002	0.001
							(0.783)	(0.354)
IVOL							65.410***	27.832*
							(4.231)	(1.896)

TABLE 3 (Continued)

	5		6		7		8	
TO							−0.160**	−0.015
							(−2.517)	(−0.335)
SIZE							−0.000*	−0.000
							(−1.970)	(−1.453)
MOM							−0.405*	−0.121
							(−1.963)	(−0.574)
REV							−2.635**	−2.172*
							(−2.215)	(−1.748)
COSKEW							−0.149	−0.127
							(−1.141)	(−0.971)
MAX							−20.278	−9.254
							(−1.374)	(−0.617)
BM							0.747***	0.193*
							(4.573)	(1.714)
ILLIQ							0.026	−0.151**
							(0.422)	(−2.374)
ROE							−0.004	−0.004
							(−1.290)	(−1.285)
I/A							−0.281***	−0.222***
							(−3.921)	(−4.251)
Constant	0.769***	0.896***	1.800***	2.279***	1.540***	1.825***	0.582	1.573***

(Continues)

TABLE 3 (Continued)

	5		6		7		8	
	(17.388)	(11.226)	(7.018)	(9.246)	(5.699)	(7.396)	(1.485)	(4.229)
Observations	1,526,082	1,526,738	1,431,293	1,431,659	1,431,293	1,431,659	625,465	625,651
R^2	0.030	0.014	0.030	0.015	0.030	0.015	0.034	0.014
Adjusted R^2	0.0211	0.0140	0.0209	0.0146	0.0209	0.0147	0.0227	0.0140
Firm FE	Yes	No	Yes	No	Yes	No	Yes	No
Industry FE	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster by year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Abbreviations: EUE, economic uncertainty exposure; FE, fixed effect; MIS, mispricing score.

The benchmark MIS effect as shown in Equation (2) is negative as expected since the higher the MIS index, the more overpriced the stock. What we are interested in is the main specification in which the EUE's mispricing effect is controlled in Equations (3) and (4). When the interaction between EUE and MIS is included, the coefficient for the interaction $EUE \times MIS$ is negative. Higher EUE would amplify the negative mispricing effect that we observed in the benchmark MIS coefficient, which supports our mispricing hypothesis. Furthermore, when the mispricing effect is fully controlled for by the benchmark MIS and the interaction, the base EUE coefficient is positive and significant (0.356%, $t = 2.95$). This captures the ambiguity-premium effect and supports our hypothesis of a positive ambiguity premium once the EUE-induced mispricing effect is controlled for. The results are consistent after controlling for other firm-level characteristics and using alternative panel data estimation methods in Panel B.

Again, our regression analyses highlight that potentially contradicting conclusions may emerge when studying the EUE effect without disentangling two channels.

4.4 | Time series variation of economic uncertainty

In this section, we further examine whether time-varying economic uncertainty affects the cross-sectional mispricing and ambiguity premium. If EUE induces heterogeneous beliefs in the stock valuation, such an effect is likely to be stronger following periods of increasing economic uncertainty. Holding everything else constant, a higher magnitude of economic uncertainty will naturally make the pricing effect stronger and easier to detect. Furthermore, from a behavioural theory point of view, increasing economic uncertainty would attract more investors' attention and leads them to rely more on their subjective beliefs.

To test this prediction, we divide the sample into two groups: month t is an increasing (decreasing) MEU month if the change of the MEU index in month t is positive (negative). This approach is similar to that used to study time variation of sentiment (M. Baker & Wurgler, 2007). There are 302 increasing and 328 decreasing MEU months in our sample, respectively.

We obtain risk-adjusted returns following the increasing and decreasing MEU periods by modifying our main model using two subperiod intercept dummies:

$$R_{p,t} = \alpha_H d_{H,t-1} + \alpha_L d_{L,t-1} + \beta_{p,1} MKT_t + \beta_{p,2} SMB_t + \beta_{p,3} HML_t + \beta_{p,4} UMD_t + \beta_{p,5} IA_t + \beta_{p,6} ROE_t + \varepsilon_{i,t}, \quad (5)$$

where $R_{p,t}$ is the excess return of portfolio p in month t. $d_{H,t-1}$ and $d_{L,t-1}$ are dummy variables indicating increasing and decreasing MEU periods, respectively. MKT_t, SMB_t, HML_t, UMD_t, IA_t and ROE_t are Fama and French market factors in month t. Table 4 reports risk-adjusted returns following increasing and decreasing MEU periods in different EUE groups.

Consistent with the prediction, the EUE effect on mispricing is much stronger following periods with increasing MEU in Panel A. The spread between underpriced and overpriced legs in the high EUE group is significant (1.21% per month, $t = 4.76$) after the increasing MEU period. This is higher than the unconditional mispricing spread (0.47% per month, $t = 3.53$) following the same period. By contrast, as shown in Panel B, following the decreasing MEU periods, the spread of mispricing portfolios in the high EUE group is about half of that following the increasing MEU periods. Additionally, the monotonic increasing pattern of returns with EUE is less clear as indicated by the insignificant difference between the high–low EUE groups in the Underpriced−Overpriced row.

TABLE 4 Portfolio returns following increasing and decreasing MEU periods

The table reports the risk-adjusted returns on five MIS (EUE) and 25 EUE–MIS value-weighted portfolios following increasing and decreasing MEU periods in Panels A and B, respectively. The 25 portfolios are formed by independently sorting on EUE and the mispricing scores. The mean of five MIS (EUE) portfolios is reported in the Average MIS (EUE) column (row). The five MIS (EUE) portfolios are formed by sorting individual stocks on their mispricing scores (EUE), reported in the univariate MIS (EUE) column (row). The risk-adjusted returns are estimates of alphas estimated by the following model: $R_{p,t} = \alpha_H d_{H,t-1} + \alpha_L d_{L,t-1} + \beta_{p,1}MKT_t + \beta_{p,2}SMB_t + \beta_{p,3}HML_t + \beta_{p,4}UMD_t + \beta_{p,5}IA_t + \beta_{p,6}ROE_t + \varepsilon_{i,t}$, where $R_{p,t}$ is the excess return of portfolio p in month t. $d_{H,t-1}$ and $d_{L,t-1}$ are dummy variables indicating the following periods with increasing and decreasing MEU changes, respectively. MKT_t, SMB_t, HML_t, UMD_t, IA_t and ROE_t are Fama and French market factors in month t. Variable definitions are listed in Appendix A. Portfolio returns are in percent and t statistics are reported in parentheses using Newey and West (1987) robust standard errors with three lags. The sample period is from July 1968 to December 2020. If the change of the MEU index by Jurado et al. (2015) in month $t-1$ is positive (negative), then month t is increasing (decreasing)-EU month. There are 302 increasing and 328 decreasing MEU months, respectively. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	Low EUE	2	3	4	High EUE	High–low	Average MIS	Univariate MIS
Panel A: High MEU Period								
1 Overpriced	−0.15	−0.04	−0.60***	−0.41**	−0.60***	−0.45**	−0.36***	−0.36***
	(−1.02)	(−0.27)	(−2.93)	(−2.54)	(−3.72)	(−2.11)	(−3.54)	(−3.49)
2	−0.08	0.09	0.00	−0.14	0.02	0.10	−0.02	−0.03
	(−0.59)	(0.68)	(0.01)	(−0.95)	(0.09)	(0.39)	(−0.36)	(−0.46)
3 Non-mispricing	−0.19	−0.07	−0.09	−0.00	0.24	0.43**	−0.02	−0.08
	(−1.62)	(−0.54)	(−0.81)	(−0.01)	(1.36)	(2.17)	(−0.31)	(−1.22)
4	0.12	−0.13	0.03	−0.13	0.06	−0.06	−0.01	−0.03
	(1.12)	(−1.17)	(0.29)	(−0.96)	(0.25)	(−0.21)	(−0.11)	(−0.49)
5 Underpriced	0.04	0.12	0.05	0.18	0.61***	0.57***	0.20***	0.11**
	(0.40)	(1.45)	(0.43)	(1.29)	(3.31)	(2.79)	(3.49)	(2.07)
Underpriced−Overpriced	0.19	0.17	0.65***	0.59***	1.21***	1.02***	0.56***	0.47***
	(1.07)	(0.88)	(2.61)	(2.76)	(4.76)	(3.68)	(4.13)	(3.53)

TABLE 4 (Continued)

	Low EUE	2	3	4	High EUE	High–low	Average MIS	Univariate MIS
Average EUE	−0.05	−0.01	−0.12*	−0.10	0.07	0.12		
	(−0.84)	(−0.09)	(−1.88)	(−1.40)	(0.61)	(0.85)		
Univariate EUE	0.00	0.05	−0.03	−0.05	0.14	0.13		
	(0.05)	(0.78)	(−0.39)	(−0.65)	(1.18)	(0.91)		
Panel B: Low MEU Period								
1 Overpriced	−0.33**	−0.02	−0.39***	−0.32**	−0.33**	−0.00	−0.28***	−0.25***
	(−2.53)	(−0.18)	(−2.85)	(−2.12)	(−2.10)	(−0.00)	(−3.51)	(−3.07)
2	0.03	−0.12	0.00	0.08	0.13	0.10	0.02	0.00
	(0.25)	(−0.94)	(0.03)	(0.60)	(0.84)	(0.52)	(0.39)	(0.02)
3 Non-mispricing	−0.06	0.15	−0.04	0.09	0.15	0.20	0.06	0.03
	(−0.53)	(1.24)	(−0.40)	(0.65)	(0.86)	(1.02)	(1.03)	(0.57)
4	0.05	−0.02	−0.04	0.17	0.16	0.11	0.07	0.05
	(0.57)	(−0.20)	(−0.36)	(1.42)	(1.00)	(0.54)	(1.30)	(0.90)
5 Underpriced	0.04	0.02	−0.02	0.10	0.12	0.08	0.05	0.01
	(0.41)	(0.27)	(−0.20)	(0.79)	(0.67)	(0.40)	(0.91)	(0.13)
Underpriced−Overpriced	0.37**	0.05	0.37**	0.41**	0.45**	0.08	0.33***	0.26**
	(2.17)	(0.28)	(2.17)	(2.20)	(1.98)	(0.28)	(3.13)	(2.36)
Average EUE	−0.05	0.00	−0.10*	0.02	0.04	0.10		
	(−1.11)	(0.07)	(−1.94)	(0.38)	(0.45)	(0.84)		
Univariate EUE	0.02	0.06	−0.10*	0.07	0.06	0.04		
	(0.37)	(1.18)	(−1.91)	(1.16)	(0.55)	(0.34)		

Abbreviations: EUE, economic uncertainty exposure; FE, fixed effect; MEU, macroeconomic uncertainty; MIS, mispricing score.

Similarly, we show that the ambiguity-premium effect is only observable following periods of increasing uncertainty. The alpha of high–low EUE portfolios in the non-mispricing group is significant (0.43% per month, $t = 2.17$) which is higher than the whole sample period results shown in Table 2.

Overall, the subperiod analysis further confirms that increasing uncertainty is the main driver of the EUE effect on asset pricing. Practically, a mispricing investment strategy that is concentrated on only stocks in the highest EUE quintile and only invested following periods with increasing economic uncertainty would earn a risk-adjusted return of 14.52% per annum (1.21% × 12) based on FF-6 factor-alpha. This is more than three times the unconditional mispricing strategy shown in Table 2. The ambiguity premium is also found to be higher following a period with increasing economic uncertainty. This suggests that economic uncertainty is indeed a driver for this ambiguity premium.

5 | FURTHER ANALYSES

In this section, we provide further analyses to examine links between the EUE and cross-sectional returns and further identify the two channels of impact.

We start by examining the two-channel responses to the economic uncertainty around the unfolding of the COVID-19 pandemic. We then examine to what extent the existing cross-sectional risk model can explain these two types of EUE effects. We extend our empirical study to consider alternative macro uncertainty measures to understand the source of information for our EUE measure. Finally, we study these two channels with controls for well-known mispricing conditions, such as limits of arbitrage and investor sentiment.

5.1 | An out-of-sample test: A case study during COVID-19 period

The initial recognition of the thread created by COVID-19 back in early 2020 has induced a jump in uncertainty in stock markets (Goldstein et al., 2021). This provides a setting for us to examine how two channels of economic uncertainty effect influence asset price during the raises and falls of uncertainty. In Figure 1, we plot the economic uncertainty index in the year 2020. The unfolding of the COVID-19 news can be classified into four subperiods: (i) prepandemic, (ii) increasing uncertainty, (iii) decreasing uncertainty and (iv) Stabilised (but still high uncertainty) periods.

We study the average daily excess return of the ambiguity premium and the mispricing effect in Panel A of Table 5. We see that the ambiguity channel indeed captures the "risk" of economic uncertainty. During the period of this risk is realised, a strategy long this risk will make a loss on average. This is because investors who dislike ambiguity will sell off the assets and push the price down, consistent with Caballero and Simsek (2021). Holding a portfolio with high exposure to this factor during this period will suffer higher losses than holding those with low or no exposure. This is confirmed in Period ii when the economic uncertainty is increasing. However, this negative premium is not statistically significant, suggesting these stocks are not performing worse than the market.[27] Once the economic uncertainty is resolved or reduced by the central bank and

[27]The ambiguity premium is measured by a long–short portfolio of the two EUE quantiles. The use of excess return or market-adjusted return will produce the same results for this portfolio as the benchmark return is cancelled out in this hedged portfolio.

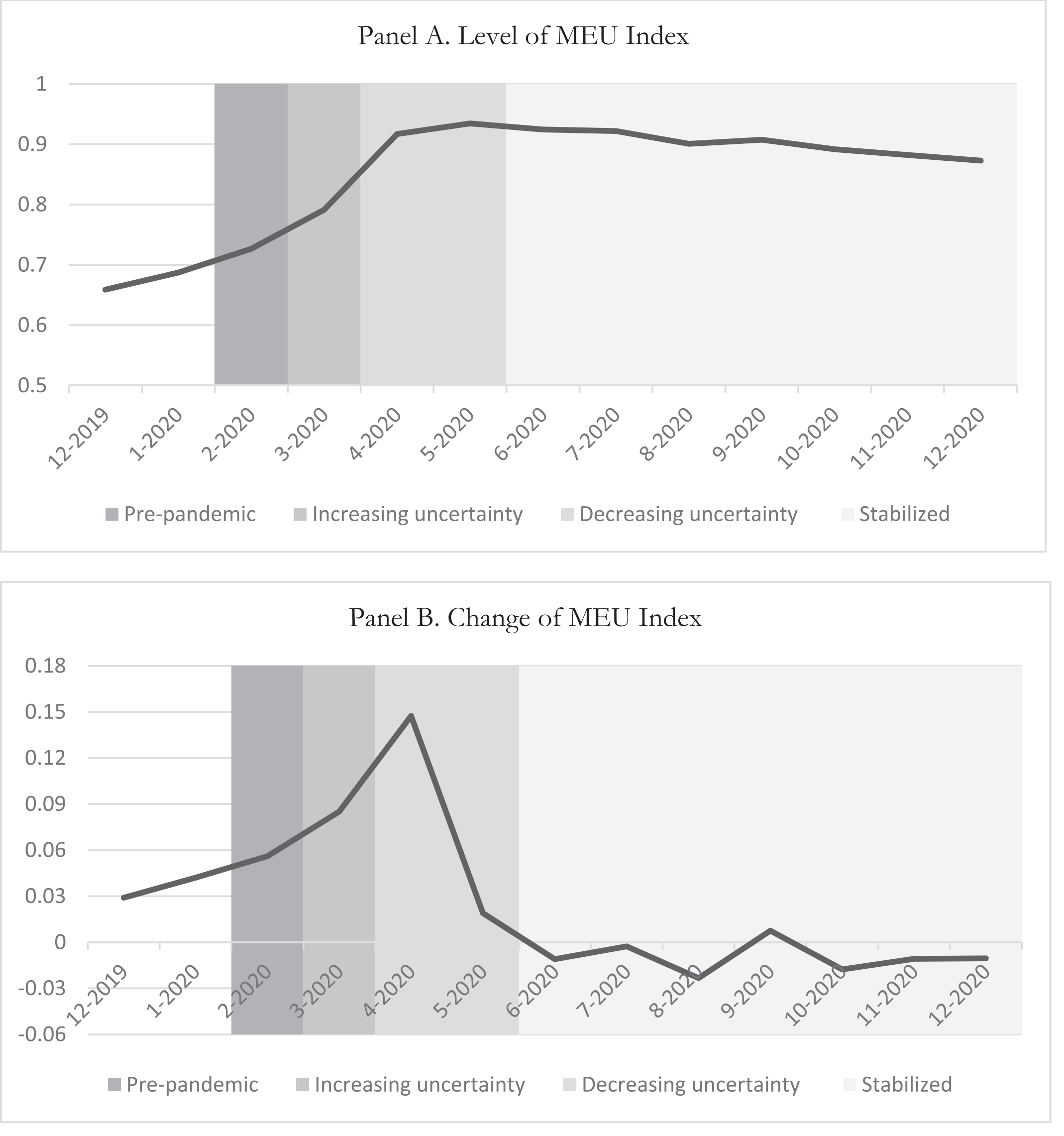

FIGURE 1 This figure plots the level of and the innovations in the economic uncertainty index by Jurado et al. (2015) in the year 2020 in Panels A and B, respectively. The unfolding of the COVID-19 news can be classified into four subperiods: (i) prepandemic (February 3–27), (ii) increasing uncertainty (February 28–March 23), (iii) decreasing uncertainty (March 24–May 29) and (iv) stabilised (but still high uncertainty) (June 1–December 31) periods.

government's assurance, we see this risk factor will earn a premium and continue to do so in periods (iii) and (iv). Therefore, investors who are willing to bear the ambiguity risk from the beginning of the event and stick with their strategies will see the payoff quite quickly in this case. This is because the uncertainty is partially resolved by the central bank and government interventions.[28]

[28]Cox et al. (2020) show Federal Reserve's five "unconventional" policy announcements between March 17 and April 30 about new credit facilities collectively contributed to shoring up risk tolerance and contributing to a stock market rebound in late March and April 2020.

TABLE 5 Portfolio returns during COVID-19 period

This table reports daily average returns on Ambiguity Premium and Mispricing Effects and the monthly risk-adjusted returns on 25 EUE–MIS value-weighted portfolios in Panels A and B, respectively. The risk-adjusted returns are estimates of alphas estimated by the following model: $R_{p,t} = \alpha_{p,1} + \beta_{p,1}MKT_t + \beta_{p,2}SMB_t + \beta_{p,3}HML_t + \beta_{p,4}UMD_t + \beta_{p,5}IA_t + \beta_{p,6}ROE_t + \varepsilon_{i,t}$, where $R_{p,t}$ is the excess return of portfolio p in month t and $\alpha_{p,1}$ is adjusted return in percent. MKT_t, SMB_t, HML_t, UMD_t, IA_t and ROE_t are Fama and French market factors in month t. Variable definitions are listed in Appendix A. Portfolio returns are in percent and t statistics are reported in parentheses using Newey and West (1987) robust standard errors with three lags. The sample period is from January 2020 to December 2020. There are 18, 17, 47 and 150 trading days in prepandemic, increasing uncertainty, decreasing uncertainty and stabilised periods, respectively. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Panel A: Excess return		Prepandemic	Increasing uncertainty	Decreasing uncertainty	Stabilised
Ambiguity premium	High–low (non-mispricing)	−0.18	−0.38	0.47*	0.28***
		(−0.45)	(−0.32)	(1.73)	(2.86)
Mispricing effect	High–low (under–over)	0.06	−0.94**	−0.02	−0.04
		(0.31)	(−2.43)	(−0.07)	(0.35)

Panel B: Alphas	Low EUE	2	3	4	High EUE	High–low	Average MIS	Univariate MIS
1 Overpriced	−2.21	−1.43	−0.39	0.20	2.20*	4.41	−0.33	−0.47
	(−1.19)	(−1.89)	(−0.82)	(0.15)	(2.07)	(1.80)	(−0.63)	(−1.56)
2	0.30	1.80	−1.87	−0.67	2.22	1.92	0.36	0.64
	(0.45)	(1.56)	(−1.70)	(−1.24)	(1.25)	(0.86)	(1.20)	(1.28)
3 Non-mispricing	0.96	0.52	1.21	−3.94***	8.90**	7.94**	1.53**	1.32
	(1.19)	(0.64)	(1.79)	(−6.03)	(3.68)	(3.59)	(2.92)	(1.96)
4	0.99***	−1.73***	−0.28	0.47	−1.85	−2.84*	−0.48	−0.04
	(4.15)	(−4.85)	(−0.62)	(1.16)	(−1.34)	(−2.21)	(−1.41)	(−0.11)
5 Underpriced	0.08	−0.41	−1.41***	−1.61*	0.36	0.27	−0.60**	−0.34**

TABLE 5 (Continued)

Panel B: Alphas	Low EUE	2	3	4	High EUE	High–low	Average MIS	Univariate MIS
	(0.21)	(−1.25)	(−8.48)	(−2.50)	(0.51)	(0.39)	(−3.38)	(−2.81)
Underpriced−	2.29	1.02	−1.02	−1.81	−1.84	−4.14	−0.27	0.13
Overpriced	(1.32)	(1.68)	(−1.97)	(−1.10)	(−1.30)	(−1.37)	(−0.63)	(0.37)
Average EUE	0.02	−0.25	−0.55	−1.11**	2.37***	2.34*		
	(0.04)	(−0.50)	(−1.80)	(−3.31)	(4.07)	(2.05)		
Univariate EUE	0.41*	−0.66*	−0.64*	−1.16**	3.56***	3.15**		
	(2.04)	(−2.32)	(−2.20)	(−3.09)	(5.46)	(3.84)		

Abbreviations: EUE, economic uncertainty exposure; MIS, mispricing score.

Furthermore, we provide the first direct evidence of economic uncertainty amplifying mispricing. We see that mispricing is intensified after the sudden increase of uncertainty in period (iii). The negative return on the high–low portfolio constructed based on the mispricing effect during this period suggests that the mispricing is further widening and there is no sign of correction yet. This negative return suggests that the underpriced stocks continued to underperform overpriced stocks.

We also report the alpha analyses in panel B of Table 5. We report the monthly alpha during the whole year period. It confirms that during this episode of large changes in uncertainty, the ambiguity premium is positive on average and much bigger than the average effect in the full sample. By contrast, the mispricing effect is relatively weaker. This suggests a more "homogeneous" response from ambiguity-averse investors while a more "heterogeneous/disagreeing" reaction from behavioural-biased investors.

5.2 | Can alternative risk models explain two channels of EUE effect?

If the real pricing process is driven by a multifactor risk model, to obtain a clear inference of a new factor, one needs to control for known factors. With the literature adding more and more risk factors to the list, we would like to understand what the marginal contribution is of bringing the EUE into consideration in the cross-sectional asset pricing. To this end, we examine the robustness of our findings with alternative risk models.

In our main results in Table 2, we use an augmented FF six-factor model defined in Equation (3). Panel A of Table 6 reports risk-adjusted returns on the selected EUE–MIS portfolios with the market model and two alternative versions of the augmented FF factor models. It shows that both mispricing and ambiguity-premium effects are robust to these risk model specifications in Panel A. The mispricing alphas are statistically significant, ranging from 0.64% to 1.44% per month in the high EUE group. All of these alphas are larger than the unconditional mispricing returns.

Collectively, results obtained when using alternative risk models reveal further insights regarding the two channels of the EUE effect. In general, when a given risk model cannot explain unconditional mispricing, EUE's amplification of the mispricing effect would also be more apparent. EUE's influence on known mispricing anomalies is weakened as more elaborated multifactor models are used as benchmark models in general. This suggests that the EUE-induced mispricing effects are partly correlated with the underlying economic drivers of those risk factors. By contrast, the ambiguity-premium effect of EUE remains strong when other risk premiums are controlled with more elaborated risk models. In fact, the largest ambiguity premium comes from the q5 model when the mispricing effect is fully explained. This demonstrates the robustness of the EUE-induced ambiguity premium as a new factor that is different from existing risk and mispricing factors.

5.3 | Does the measure of uncertainty matter?

Previous studies have used different proxies for economic uncertainty, including the SPFs (e.g., D'Amico & Orphanides, 2008; Glas & Hartmann, 2016; Li, 2016), VRP (Bali & Zhou, 2016) and the JLN measure (Bali et al., 2017). Kozeniauskas et al. (2018) show that different economic uncertainty measures are potentially capturing three different causes

TABLE 6 Effect of different risk models

This table reports the risk-adjusted returns on overpriced, underpriced and non-mispricing double-sort portfolios. The portfolios are formed by independently sorting on EUE and the mispricing scores. The univariate MIS (EUE) portfolios are reported in the univariate MIS (EUE) column (row). The risk-adjusted returns are estimates of alphas from the following models: $CAPM: \; R_{p,t} = \alpha_{p,1} + \beta_{p,1}MKT_t + \varepsilon_{i,t}$, $FF5: \; R_{p,t} = \alpha_{p,1} + \beta_{p,1}MKT_t + \beta_{p,2}SMB_t + \beta_{p,3}HML_t + \beta_{p,4}IA_t + \beta_{p,5}ROE_t + \varepsilon_{i,t}$, $FF7: \; R_{p,t} = \alpha_{p,1} + \beta_{p,1}MKT_t + \beta_{p,2}SMB_t + \beta_{p,3}HML_t + \beta_{p,4}UMD_t + \beta_{p,5}IA_t + \beta_{p,6}ROE_t + \beta_{p,7}LIQ_t$ $q4: \; R_{p,t} = \alpha_{p,1} + \beta_{p,1}MKT_t + \beta_{p,2}QSMB_t + \beta_{p,3}QIA_t + \beta_{p,4}QROE_t + \varepsilon_{i,t}$, $q5: \; R_{p,t} = \alpha_{p,1} + \beta_{p,1}MKT_t + \beta_{p,2}QSMB_t + \beta_{p,3}QIA_t + \beta_{p,4}QROE_t + \beta_{p,5}QEG_t + \varepsilon_{i,t}$, $MSP: \; R_{p,t} = \alpha_{p,1} + \beta_{p,1}MKT_t + \beta_{p,2}MSMB_t + \beta_{p,3}MGMT_t + \beta_{p,4}PERF_t + \varepsilon_{i,t}$, where $R_{p,t}$ is the excess return of portfolio p in month t and $\alpha_{p,1}$ is adjusted return in percent. MKT_t, SMB_t, HML_t, UMD_t, IA_t and ROE_t are Fama and French market factors and LIQ_t is the level of aggregate market liquidity in month t. $QSMB_t$, QIA_t, $QROE_t$ and QEG_t are Hou et al. (2015) and Hou et al. (2021) q-factors in month t. $MSMB_t$ $MGMT_t$ and $PERF_t$ are Stambaugh and Yuan (2017) mispricing factors in month t. Variable definitions are listed in Appendix A. Portfolio returns are in percent and t statistics are reported in parentheses using Newey and West (1987) robust standard errors with three lags. The sample period is from July 1968 to December 2016 for MSP and to December 2020 for the other models. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	CAPM				FF5				FF7			
	Low	High	High-Low	Univariate MIS	Low	High	High-Low	Univariate MIS	Low	High	High-Low	Univariate MIS
Panel A: CAPM and Fama French models												
1 Overpriced	−0.41***	−1.00***	−0.60***	−0.65***	−0.35***	−0.62***	−0.28*	−0.48***	−0.26**	−0.41***	−0.15	−0.25***
	(−3.61)	(−6.30)	(−3.07)	(−7.09)	(−3.25)	(−4.61)	(−1.79)	(−5.09)	(−2.27)	(−3.34)	(−0.80)	(−3.34)
3 Non-mispricing	−0.04	0.02	0.06	−0.04	−0.17**	0.25*	0.42**	−0.04	−0.09	0.21	0.29*	0.01
	(−0.50)	(0.13)	(0.34)	(−0.90)	(−2.16)	(1.82)	(2.55)	(−1.10)	(−0.97)	(1.50)	(1.71)	(0.19)
5 Underpriced	0.31***	0.43***	0.12	0.25***	0.10	0.49***	0.38**	0.13***	−0.02	0.23*	0.25	0.03
	(3.61)	(3.18)	(0.73)	(5.27)	(1.44)	(3.53)	(2.54)	(3.08)	(−0.26)	(1.66)	(1.55)	(0.78)
Underpriced −Overpriced	0.71***	1.44***	0.72***	0.90***	0.45***	1.11***	0.66***	0.61***	0.24*	0.64***	0.39*	0.28***
	(5.21)	(7.14)	(3.40)	(7.11)	(3.39)	(5.37)	(3.19)	(4.92)	(1.76)	(3.51)	(1.70)	(2.92)
Univariate EUE	0.11**	−0.15	−0.26*		0.01	0.11	0.10		0.01	0.07	0.06	
	(2.56)	(−1.33)	(−1.82)		(0.35)	(1.26)	(0.90)		(0.16)	(0.81)	(0.56)	

TABLE 6 (Continued)

	q4				q5				MSP			
	Low	High	High-Low	Univariate MIS	Low	High	High-Low	Univariate MIS	Low	High	High-Low	Univariate MIS
Panel B: Investment-based q and mispricing models												
1 Overpriced	−0.32**	−0.47***	−0.15	−0.41***	−0.19	−0.16	0.03	−0.12	−0.14	−0.17	−0.03	−0.07
	(−2.55)	(−3.70)	(−0.90)	(−3.66)	(−1.52)	(−1.20)	(0.17)	(−1.22)	(−1.30)	(−1.50)	(−0.18)	(−1.27)
3 Non-mispricing	−0.14	0.31*	0.45**	−0.02	−0.03	0.47**	0.50**	0.10**	−0.11	0.31**	0.41**	0.02
	(−1.49)	(1.72)	(2.10)	(−0.49)	(−0.29)	(2.57)	(2.52)	(2.00)	(−1.14)	(2.31)	(2.50)	(0.45)
5 Underpriced	0.07	0.39**	0.32*	0.08*	−0.11	0.17	0.28	−0.11**	−0.12	0.24*	0.36**	−0.08**
	(0.92)	(2.55)	(1.90)	(1.70)	(−1.32)	(1.08)	(1.56)	(−2.33)	(−1.42)	(1.68)	(2.02)	(−2.21)
Underpriced −Overpriced	0.39**	0.86***	0.47**	0.49***	0.07	0.33	0.25	0.01	0.02	0.42**	0.40*	−0.01
	(2.52)	(4.07)	(2.14)	(3.35)	(0.48)	(1.64)	(1.09)	(0.07)	(0.16)	(2.48)	(1.66)	(−0.08)
Univariate EUE	0.01	0.16	0.15		−0.04	0.23**	0.27**		−0.05	0.16**	0.21*	
	(0.31)	(1.36)	(1.03)		(−0.87)	(2.09)	(1.99)		(−1.07)	(1.97)	(1.92)	

Abbreviations: EUE, economic uncertainty exposure; MIS, mispricing score.

driving economic agents to become uncertain. Mixed findings in the previous literature may be due to the choice of proxies. To verify if our findings are unique due to the use of the JLN uncertainty measure, we provide a unified study to compare the difference among these measures. For analysis using macro forecasters' dispersions, following Li (2016), we consider dispersion in various economic forecasts including GDP, INPR and RNRSN at the growth rates, unemployment rate (UNEM), Treasury-bill (TBILL) and inflation rate (CPI). The cross-sectional forecast dispersions are measured as the difference between the 75th percentile and 25th percentile of quarterly forecasts from the SPFs database.[29] We estimate quarterly macro-disagreement beta for each measure separately from a 20-quarter rolling regression for each stock with the model specified in Equation (2) by replacing ΔUNC_t with the log changes of these macro-dispersion proxies. Similar to the main analysis, we measure the exposure to these macro-dispersions by the absolute value of beta (hereafter ADSM). Since this measure is updated quarterly, the same beta from the prior quarter-end is used to form portfolios each month within the same quarter. Finally, the 25 ADSM–MIS portfolios are formed as intersections of five ADSM-beta and the five MIS groups, and value-weighted portfolio returns are calculated.

The results in Table 7 provide additional evidence to support our main findings that MEU measured by macro-disagreement amplifies mispricing of the anomalies. The alphas of the "Underpriced−Overpriced" portfolios in the high ADSM quintiles are statistically positive for all dispersion measures, ranging from 0.33% to 0.88% per month. These results suggest that our findings regarding the amplification effect are not specific to a particular uncertainty measure. However, the ambiguity-premium effect is less observable in the non-mispricing group when using these proxies,[30] and it exists in three out of the six measures when using the dispersion of growth in UNEM, RNRSN and inflation (CPI) forecasts.

In addition to the dispersion of these macro forecasts, S. R. Baker et al. (2016) develop an index of economic policy uncertainty (EPU) based on newspaper coverage frequency and demonstrate its relevance to firm-level volatility, investment and innovations.[31] Bali and Zhou (2016) study the VRP as a proxy for economic uncertainty.[32] Brenner and Izhakian (2018) measure the degree of ambiguity by the volatility of probabilities of outcomes abstracted from high-frequency S&P 500 derivative data.[33] Istrefi and Mouabbi (2018) capture subjective uncertainty about interest rates based on the disagreement among forecasters measuring the conditional variance of forecast errors[34].

We repeat the same analyses with these four uncertainty proxies. As in our EUE estimation, we estimate these uncertainty exposure betas from a 60-month rolling regression for each stock by replacing ΔUNC_t with the log changes of the EPU index, variance risk factor, the ambiguity

[29]https://www.philadelphiafed.org/research-and-data/real-time-center/survey-of-professional-forecasters (accessed in July 2021). To form each of those macro-disagreement proxies, we take the mean value of the available forecast dispersion at all forecast horizons (Li, 2016).

[30]Similarly, the unconditional effect of these macro-disagreement exposures is not observable with the exception of using the TBILL dispersion. This is consistent with Li (2016), who fails to find the unconditional pricing effect.

[31]The monthly EPU index is taken from: https://www.policyuncertainty.com/ (accessed in July 2021).

[32]They define the VRP factor as "the difference between expected variance under the risk-neutral measure and expected variance under the objective measure in the U.S. equity market." The monthly factor is taken from Zhou's website: https://sites.google.com/site/haozhoupersonalhomepage/ (accessed in July 2021).

[33]We are grateful to Yud Izhakian (the City University of New York) for sharing his ambiguity index data with us.

[34]They show that shocks to interest rate uncertainty induce economic downturns in INPR and unemployment. The monthly uncertainty index on 3-month interest rate is gathered from: https://sites.google.com/site/sarahmouabbi/interest-rate-uncertainty?authuser=0 (accessed in September 2022).

TABLE 7 Source of uncertainty I: Macro-disagreement measured by the survey of professional forecasters

This table reports the risk-adjusted returns on overpriced, underpriced and non-mispricing double-sort portfolios. Those macro-disagreement variables are forecast dispersion in the unemployment rate (UNEM), growth in GDP, industrial production (INPR), nonresidential fixed investment (RNRSN), the level of Treasury-bill (TBILL) and inflation rate (CPI). The portfolios are formed by independently sorting the absolute value of macro-disagreement (ADSM) betas and the mispricing score. The mean of ADSM portfolios is reported in the Average ADSM row. The risk-adjusted returns are estimates of alphas estimated by the following model: $R_{p,t} = \alpha_{p,1} + \beta_{p,1}MKT_t + \beta_{p,2}SMB_t + \beta_{p,3}HML_t + \beta_{p,4}UMD_t + \beta_{p,5}IA_t + \beta_{p,6}ROE_t + \varepsilon_{i,t}$, where $R_{p,t}$ is the excess return of portfolio p in month t and $\alpha_{p,1}$ is adjusted return in percent. MKT_t, SMB_t, HML_t, UMD_t, IA_t and ROE_t are Fama and French market factors in month t. Variable definitions are listed in Appendix A. Portfolio returns are in percent and t statistics are reported in parentheses using Newey and West (1987) robust standard errors with three lags. The sample period is from January 1974 for UNEM, GDP and INPR and from October 1986 for RNRSN, TBILL and CPI to December 2020. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	Low $ADSM^{GDP}$	High $ADSM^{GDP}$	High−low	Low $ADSM^{INPR}$	High $ADSM^{INPR}$	High−low	Low $ADSM^{UNEM}$	High $ADSM^{UNEM}$	High−low
1 Overpriced	−0.19	−0.47***	−0.28	−0.07	−0.24*	−0.17	−0.11	−0.56***	−0.44**
	(−1.55)	(−3.34)	(−1.51)	(−0.65)	(−1.81)	(−0.99)	(−0.96)	(−4.20)	(−2.51)
3 Non-mispricing	−0.12	0.11	0.23	−0.08	0.11	0.19	−0.25***	0.28**	0.53***
	(−1.23)	(0.84)	(1.55)	(−0.92)	(0.76)	(1.06)	(−2.71)	(2.17)	(3.15)
5 Underpriced	0.04	0.28*	0.23	−0.12	0.09	0.21	−0.04	0.26*	0.30*
	(0.66)	(1.81)	(1.35)	(−1.59)	(0.78)	(1.58)	(−0.59)	(1.95)	(1.92)
Underpriced−Overpriced	0.23	0.75***	0.51**	−0.05	0.33*	0.38*	0.07	0.81***	0.74***
	(1.59)	(3.62)	(2.06)	(−0.33)	(1.86)	(1.73)	(0.52)	(4.14)	(3.26)
Univariate	0.01	0.04	0.03	−0.07*	0.16**	0.23**	−0.09**	0.14*	0.23**
	(0.35)	(0.53)	(0.31)	(−1.77)	(2.03)	(2.39)	(−2.38)	(1.79)	(2.27)
	Low $ADSM^{TBILL}$	**High $ADSM^{TBILL}$**	**High−low**	**Low $ADSM^{RNRSN}$**	**High $ADSM^{RNRSN}$**	**High−low**	**Low $ADSM^{CPI}$**	**High $ADSM^{CPI}$**	**High−low**
1 Overpriced	−0.07	−0.39***	−0.32	−0.29*	−0.41***	−0.11	−0.17	−0.44***	−0.27
	(−0.49)	(−2.71)	(−1.63)	(−1.74)	(−2.68)	(−0.53)	(−0.98)	(−3.05)	(−1.18)

TABLE 7 (Continued)

	Low $ADSM^{TBILL}$	High $ADSM^{TBILL}$	High–low	Low $ADSM^{RNRSN}$	High $ADSM^{RNRSN}$	High–low	Low $ADSM^{CPI}$	High $ADSM^{CPI}$	High–low
3 Non-mispricing	−0.07	0.06	0.14	−0.15	0.14	0.30	−0.08	0.42**	0.50**
	(−0.76)	(0.42)	(0.79)	(−1.46)	(1.01)	(1.65)	(−0.65)	(2.36)	(2.51)
5 Underpriced	0.06	−0.03	−0.09	−0.16**	0.32**	0.48***	−0.05	0.43**	0.48**
	(0.72)	(−0.20)	(−0.49)	(−2.02)	(2.05)	(2.64)	(−0.66)	(2.50)	(2.37)
Underpriced−Overpriced	0.13	0.36*	0.24	0.14	0.73***	0.59**	0.13	0.88***	0.75**
	(0.78)	(1.80)	(0.95)	(0.76)	(3.28)	(2.31)	(0.64)	(3.83)	(2.55)
Univariate	0.01	0.01	−0.00	−0.10**	0.22**	0.32***	−0.00	0.27***	0.27**
	(0.22)	(0.06)	(−0.04)	(−2.33)	(2.51)	(2.94)	(−0.08)	(2.93)	(2.43)

Abbreviations: EUE, economic uncertainty exposure; GDP, gross domestic product; MIS, mispricing score.

degree index or the interest rate uncertainty index in Equation (2).[35] We collect the absolute value of monthly estimated EPU exposure (EPUE), variance risk exposure (VRE), ambiguity degree exposure (ADE) and idiosyncratic uncertainty exposure (IUE) for each stock. Then, we form 25 independent double-sorted EPUE/VRE/ADE/IUE–MIS portfolios.

Table 8 reports the main findings. Similar to our finding in Table 7, using these alternative uncertainty measures reproduces the mispricing effect but less of the ambiguity-premium effect. Among these three, the IUE captures the strongest mispricing effects, but it is smaller than that in our main result. For the ambiguity premium, no evidence of it is found in VRE, ADE or IUE[36]. However, there is evidence of the high EPUE has a significant positive alpha, and the high–low EPUE produces a 0.40% monthly ambiguity premium (with a *t* statistic of 1.96).

Collectively, these further tests highlight the advantage of using a comprehensive and aggregated economic uncertainty measure, such as the JLN series, which can capture both the ambiguity premium and mispricing effects. In addition, we also conduct our main analyses using the financial uncertainty index by Ludvigson et al. (2021) and the real economic uncertainty index by Jurado et al. (2015).[37] We report these analyses in the Supporting Information Table OA.8. Our main findings are also robust to the choice of these uncertainty indexes. Furthermore, comparing the financial and the real economic index results, we find that the financial uncertainty plays a more important role in affecting the mispricing channel whereas the real economic uncertainty is more important in affecting the ambiguity channel.

5.4 | Does economic uncertainty lead to disagreement?

We build our hypotheses on the assumption that high EUE leads to high disagreement on valuation, which amplifies mispricing (with short-sale constraints) and induces a risk premium due to ambiguity aversion. Therefore, we would expect that EUE would have a direct impact on traditional disagreement measures, such as volume (Hong & Stein, 2007), IVOL (Stambaugh et al., 2015) and analysts' forecast dispersions (Diether et al., 2002). We test the effect of firm-level EUE on individual stocks' disagreement variables by firm-level panel regressions in Table 9.

The results in Table 9 show that EUE can positively predict next-period stock-level disagreements, even after controlling for their own lagged terms and other time-varying firm characteristics. Overall, consistent with our conjecture, the higher the EUE for a stock, the larger the divergence of opinion, providing support for dynamic models documented in

[35]Since the VRP factor itself is a risk factor that measures innovation in the VRP series, we do not record a difference like other MEU proxies.

[36]This finding of the absence of an overall ambiguity premium is consistent with Brenner and Izhakian (2018), who show that an ambiguity premium is contingent on the expected probability of the positive and negative outcomes. We show that aggregate ambiguity will have an asymmetric effect on stocks that are subject to over- and underpricing, which complements their findings. However, it poses a question on how to interpret the effect of their measure. Their ambiguity measure is different from the MEU measure we use. Their measure is probability-based, which relies on market data to capture the volatility in the probability. What drives the underlying ambiguity is not specified under such empirical measure. This is possibly the reason that even controlling for mispricing, their measure still does not carry a significant premium.

[37]https://www.sydneyludvigson.com/macro-and-financial-uncertainty-indexes (accessed in September 2022).

TABLE 8 Source of uncertainty II: Economic policy uncertainty index, variance risk factor, ambiguity degree index and idiosyncratic uncertainty index

This table reports the risk-adjusted returns on 25 EPUE/VRE/ADE/IUE–MIS value-weighted portfolios. The 25 portfolios are formed by independently sorting on EPUE/VRE/ADE/IUE betas and the mispricing score. The mean of 5 EPUE/VRE/ADE/IUE portfolios is reported in the last row. The risk-adjusted returns are estimates of alphas estimated by the following model: $R_{p,t} = \alpha_{p,1} + \beta_{p,1}MKT_t + \beta_{p,2}SMB_t + \beta_{p,3}HML_t + \beta_{p,4}UMD_t + \beta_{p,5}IA_t + \beta_{p,6}ROE_t + \varepsilon_{i,t}$, where $R_{p,t}$ is the excess return of portfolio p in month t and $\alpha_{p,1}$ is adjusted return in percent. MKT_t, SMB_t, HML_t, UMD_t, IA_t and ROE_t are Fama and French market factors in month t. Variable definitions are listed in Appendix A. Portfolio returns are in percent and t statistics are reported in parentheses using Newey and West (1987) robust standard errors with three lags. The sample period is from January 1990 for EPUE, January 1995 for VRE, March 1998 for ADE to December 2020 and from May 1998 to July 2019 for IUE. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	Economic policy uncertainty index				**Variance risk factor**			
	Low EPUE	**High EPUE**	**High–low**	**Univariate MIS**	**Low VRE**	**High VRE**	**High–low**	**Univariate MIS**
1 Overpriced	−0.19	−0.30**	−0.12	−0.34***	−0.37**	−0.47***	−0.10	−0.39***
	(−1.20)	(−2.06)	(−0.56)	(−3.58)	(−2.32)	(−2.90)	(−0.44)	(−3.64)
3 Non-mispricing	0.05	0.45***	0.40*	−0.03	−0.07	0.30	0.37	−0.05
	(0.46)	(2.72)	(1.96)	(−0.48)	(−0.61)	(1.43)	(1.46)	(−0.82)
5 Underpriced	−0.03	0.39**	0.41**	−0.00	−0.06	0.19	0.25	0.01
	(−0.31)	(2.20)	(2.07)	(−0.09)	(−0.66)	(1.12)	(1.19)	(0.32)
Underpriced−Overpriced	0.16	0.69***	0.53*	0.34***	0.31*	0.66***	0.35	0.41***
	(0.87)	(2.83)	(1.73)	(2.93)	(1.72)	(2.96)	(1.27)	(3.13)
Univariate	0.02	0.30***	0.28***		−0.01	0.17	0.18	
	(0.47)	(3.65)	(2.87)		(−0.22)	(1.65)	(1.46)	
	Ambiguity degree index				**Idiosyncratic uncertainty index**			
	Low ADE	**High ADE**	**High–low**	**Univariate MIS**	**Low IUE**	**High IUE**	**High–low**	**Univariate MIS**
1 Overpriced	−0.21	−0.61***	−0.40**	−0.42***	−0.23	−0.78***	−0.55***	−0.43***
	(−1.15)	(−3.59)	(−2.04)	(−3.52)	(−1.39)	(−4.20)	(−2.69)	(−3.58)

(Continues)

TABLE 8 (Continued)

	Ambiguity degree index				Idiosyncratic uncertainty index			
	Low ADE	High ADE	High–low	Univariate MIS	Low IUE	High IUE	High–low	Univariate MIS
3 Non-mispricing	−0.24	0.18	0.42	−0.03	0.10	0.08	−0.02	−0.01
	(−1.60)	(0.88)	(1.56)	(−0.38)	(0.82)	(0.38)	(−0.08)	(−0.19)
5 Underpriced	−0.13	0.06	0.19	0.00	−0.05	−0.07	−0.02	−0.01
	(−1.31)	(0.27)	(0.72)	(0.06)	(−0.45)	(−0.28)	(−0.08)	(−0.15)
Underpriced−Overpriced	0.08	0.67**	0.59*	0.42***	0.18	0.72**	0.53	0.43***
	(0.39)	(2.18)	(1.75)	(2.95)	(0.91)	(2.25)	(1.61)	(2.93)
Univariate	−0.03	0.03	0.07		0.03	−0.07	−0.11	
	(−0.57)	(0.25)	(0.42)		(0.60)	(−0.50)	(−0.64)	

Abbreviations: ADE, ambiguity degree exposure; EPU, economic policy uncertainty; EPUE, EPU exposure; IUE, idiosyncratic uncertainty exposure; MIS, mispricing score; VRE, variance risk exposure.

TABLE 9 Economic uncertainty exposure and firm-level disagreements

This table reports panel predictive regressions of firm-level disagreement and EUE using the following model: $Y_{p,t} = \lambda_{0,t-1} + \lambda_1 EUE_{p,t-1} + \sum_{J=2}^{n} \lambda_j X_{p,t-1} + Fixed\ \ Effects + \varepsilon_{i,t}$, where $Y_{p,t}$ is one of the disagreement variables for stock p in month t, such as *DISP, IVOL, TO* and *EUE*. $X_{p,t-1}$ is a set of stock-specific variables in month $t-1$ for stock p, including those disagreement variables, *SIZE, MOM, REV, BM*, and *ILLIQ*. Variable definitions are listed in Appendix A. All variables in those regressions are winsorised at the fifth and 95th percentiles and the regressions are weighted with the market capitalisation to reduce the size effect in the estimates. Firm and year fixed effects are included in the model to control for heterogeneity across firms and the influence of time series. Standard errors are double-clustered at the firm and the year levels. The slope coefficients are in percent and t statistics are reported in parentheses. The sample period is from December 1981 to December 2020, due to DISP availability. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	DISP	*IVOL*	*TO*	*EUE*
EUE	0.004**	0.001***	0.072***	0.920***
	(2.523)	(10.089)	(7.860)	(113.576)
DISP	0.793***	0.000	0.041**	0.001
	(27.619)	(1.057)	(2.422)	(1.093)
IVOL	0.726	0.210***	−9.274***	0.210
	(1.227)	(8.698)	(−5.753)	(1.094)
TO	0.005***	0.000***	0.635***	0.001
	(3.792)	(4.882)	(37.733)	(1.173)
SIZE	−0.000*	−0.000***	−0.000***	0.000*
	(−1.969)	(−3.219)	(−9.662)	(1.723)
MOM	−0.017***	0.000	0.053*	0.002
	(−3.404)	(0.071)	(1.855)	(0.873)
REV	−0.025	−0.003***	0.034	−0.009
	(−1.103)	(−3.257)	(0.394)	(−1.335)
BM	0.031***	−0.000	−0.019	0.005**
	(4.076)	(−0.491)	(−0.709)	(2.192)
ILLIQ	0.001	0.002***	0.020	0.001
	(0.498)	(8.917)	(1.513)	(0.561)
Constant	0.062***	0.010***	0.912***	0.024***
	(5.624)	(18.113)	(23.473)	(5.301)
Observations	650,988	650,712	650,970	651,008
R^2	0.719	0.473	0.761	0.914
Adjusted R^2	0.716	0.467	0.759	0.913
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cluster by firm	Yes	Yes	Yes	Yes
Cluster by year	Yes	Yes	Yes	Yes

Abbreviations: EUE, economic uncertainty exposure; FE, fixed effect.

Harrison and Kreps (1978) and Hong and Sraer (2016).[38] By contrast, none of the firm-level characteristics can positively predict next-period firm-level exposure to economic uncertainty. This confirms the unique information that the EUE captures.[39]

5.5 | Limits of arbitrage and mispricing

There is a positive relation between IVOL and mispricing as shown by Stambaugh et al. (2015). IVOL deters arbitrageurs from correcting mispricing, resulting in high levels of mispricing among stocks with high IVOL. Furthermore, short-sale constraints induce arbitrage asymmetry and make the effect of IVOL on overpricing much stronger than that of underpricing. Both IVOL and EUE-induced mispricing effects are built on similar key arguments, such as disagreement, short-sale constraints and limits of arbitrage. The causality analyses in the previous section further confirm interlinks between these two firm-level measures. Can the effect of EUE on mispricing simply be a reflection of that of IVOL? To unravel the effect of IVOL from that of EUE on mispricing, we extend our main analyses of double-sorting to three dimensions. We form 50 portfolios by independently sorting stocks into two IVOL, five EUE and five MIS groups.

Table 10 reports risk-adjusted returns on 25 value-weighted EUE–MIS portfolios for low and high IVOL groups in Panels A and B, respectively. It shows that EUE and IVOL are two different sources of friction that induce mispricing. The effect of EUE on mispricing is more prominent in the group with low IVOL, where traditionally the mispricing effect is weak as arbitrage friction is low. From the limits of arbitrage point of view, we uncover EUE as a source of arbitrage friction that is not captured by the IVOL. Furthermore, consistent with the findings in previous sections, the ambiguity-premium effect is stronger when the overall unconditional mispricing effect is weak. We find that the ambiguity-premium effect is strong in the group of stocks with low arbitrage friction, further confirming its nature of "risk" premium instead of another mispricing factor.[40]

5.6 | Investor sentiment and mispricing

Existing studies have shown the role of investor sentiment in mispricing. Stambaugh et al. (2012, p. 290) suggest that "[D]uring such periods (high investor sentiment), the most optimistic views about many stocks tend to be overly optimistic, and many stocks tend to be

[38]Consistent results can also be found in the double-sort portfolios. In Table OA.5 of the Supporting Information, stocks with high MEU exposures tend to have higher turnover, high IVOL and analyst earnings forecast dispersion, showing that those assets are difficult to value and subject to a high level of disagreement.

[39]At an aggregate level, we expect that high MEU is likely to induce more disagreement and hence more trading volume (Hong & Stein, 2007). To test this, we run a time series causality regression between the change of aggregate turnover in the S&P 500 index and the change of MEU for the sample period between July 1968 and December 2020. We find that innovations in the MEU index can positively predict the next period change of the aggregate turnover at a 5% significance level, but no evidence for the reverse causality. See results in Table OA.6 of the Supporting Information.

[40]We also examine the effect of MEU on mispricing considering other proxies for limits of arbitrage and short-sale constraints, such as institutional ownership (Nagel, 2005) and size (Lee et al., 1991) reported in Table OA.7 of the Supporting Information. In particular, the EUE mispricing effects are significant in both subsamples with high and low limits of arbitrage measures; and are slightly more pronounced in the subsample with a higher level of limits to arbitrage (e.g., fewer institutional investors and smaller in size). Consistent with our main finding in this section, the ambiguity premium effect is only found in the subsample where there is a lower level of mispricing given a lower limit of arbitrage (e.g., more institutional ownership and larger in size).

TABLE 10 Triple sorts on IVOL, EUE and MIS

This table reports risk-adjusted returns on 50 value-weighted portfolios formed by sorting independently stocks on the two IVOL, five EUE and five MIS groups. The five MIS (EUE) portfolios are formed by sorting individual stocks on their mispricing scores (EUE), reported in the univariate MIS (EUE) column (row) for each IVOL group. The results among low and high IVOL groups are reported in Panel A and Panel B, respectively. The risk-adjusted returns are estimates of alphas estimated by the following model: $R_{p,t} = \alpha_{p,1} + \beta_{p,1}MKT_t + \beta_{p,2}SMB_t + \beta_{p,3}HML_t + \beta_{p,4}UMD_t + \beta_{p,5}IA_t + \beta_{p,6}ROE_t + \varepsilon_{i,t}$, where $R_{p,t}$ is the excess return of portfolio p in month t and $\alpha_{p,1}$ is adjusted return. MKT_t, SMB_t, HML_t, UMD_t, IA_t and ROE_t are Fama and French market factors in month t. Variable definitions are listed in Appendix A. Portfolio returns are in percent and t statistics are reported in parentheses using Newey and West (1987) robust standard errors with three lags. The sample period is from July 1968 to December 2020. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Panel A: Low IVOL

	Low EUE	2	3	4	High EUE	High–low	Univariate MIS
Overpriced	−0.15	−0.01	−0.33***	−0.36**	−0.51***	−0.36*	−0.20**
	(−1.39)	(−0.10)	(−2.73)	(−2.45)	(−3.01)	(−1.74)	(−2.49)
2	0.03	−0.06	−0.06	−0.16	−0.07	−0.10	−0.04
	(0.28)	(−0.56)	(−0.60)	(−1.29)	(−0.48)	(−0.53)	(−0.72)
3 Non-mispricing	−0.20**	0.07	−0.13	−0.05	0.21	0.41**	−0.07
	(−2.12)	(0.59)	(−1.55)	(−0.42)	(1.15)	(2.06)	(−1.26)
4	0.11	−0.08	0.04	−0.02	0.21	0.09	0.02
	(1.44)	(−1.01)	(0.40)	(−0.20)	(1.28)	(0.49)	(0.32)
Underpriced	0.01	0.05	0.00	0.04	0.37**	0.37**	0.03
	(0.08)	(0.77)	(0.02)	(0.44)	(2.54)	(2.31)	(0.64)
Underpriced −Overpriced	0.16	0.06	0.33**	0.40**	0.88***	0.73***	0.22**
	(1.20)	(0.43)	(2.39)	(2.38)	(4.04)	(2.84)	(2.43)
Univariate EUE	0.01	0.03	−0.05	−0.03	0.15	0.14	
	(0.23)	(0.76)	(−0.92)	(−0.54)	(1.39)	(1.16)	

Panel B: High IVOL

	Low EUE	2	3	4	High EUE	High–low	Univariate MIS
Overpriced	−0.53***	−0.31**	−0.85***	−0.41***	−0.44***	0.09	−0.54***
	(−3.11)	(−2.01)	(−4.19)	(−2.86)	(−3.32)	(0.47)	(−5.47)
2	−0.33**	0.01	0.05	0.10	0.02	0.35*	−0.06
	(−2.06)	(0.03)	(0.38)	(0.54)	(0.15)	(1.70)	(−0.64)
3 Non-mispricing	−0.04	−0.03	0.06	0.19	0.11	0.15	0.02
	(−0.26)	(−0.19)	(0.37)	(1.25)	(0.77)	(0.80)	(0.27)
4	0.18	0.10	−0.07	0.09	−0.11	−0.29	0.03

(Continues)

TABLE 10 (Continued)

Panel B: High IVOL	Low EUE	2	3	4	High EUE	High–low	Univariate MIS
	(0.97)	(0.69)	(−0.45)	(0.59)	(−0.60)	(−1.18)	(0.30)
Underpriced	0.41**	0.37**	0.25*	0.35**	0.26	−0.15	0.38***
	(2.34)	(2.27)	(1.67)	(2.21)	(1.44)	(−0.64)	(3.88)
Underpriced −Overpriced	0.94***	0.68***	1.10***	0.77***	0.70***	−0.24	0.92***
	(4.06)	(3.22)	(4.21)	(3.49)	(3.29)	(−0.85)	(6.66)
Univariate EUE	−0.02	0.13	−0.10	0.10	−0.02	−0.00	
	(−0.26)	(1.37)	(−1.13)	(1.06)	(−0.25)	(−0.01)	

Abbreviations: EUE, economic uncertainty exposure; IVOL, idiosyncratic volatility; MIS, mispricing score.

overpriced. During low-sentiment periods, the most optimistic views about many stocks tend to be those of the rational investors, and thus mispricing during those periods is less likely." We, therefore, expect that the EUE-induced mispricing effect will be more pronounced following high-sentiment periods. In contrast, the ambiguity-premium effect should be less affected by the market-wide sentiment and more likely to be observed following low-sentiment periods when investors behave more rationally, as Stambaugh et al. (2012) suggest.

To verify this, we capture alphas following the high- and low-sentiment periods in regressions that are similar to Equation (5) in Section 4.4 by replacing two dummy variables distinguishing increasing and decreasing MEU periods with dummy variables distinguishing periods with high or low-sentiment.[41]

Table 11 reports risk-adjusted returns on 25 EUE–MIS portfolios constructed following high- and low-sentiment periods. Consistent with the prediction, the MEU effect on mispricing is only significant during high-sentiment months. By contrast, the ambiguity-premium effect is only significant following low-sentiment periods. It provides further supportive evidence that the ambiguity-premium effect is more likely to be attributed to rational pricing rather than mispricing.

Shen et al. (2017) find that "macro risk-premium" is only observed when there is low investor sentiment, whereas the exact opposite occurs following high-sentiment periods since the mispricing effect is dominant. Their conclusion is drawn on aggregate return behaviour. We take one step further by decomposing these two channels of effects clearly and providing direct evidence on the different returns that can be attributed to ambiguity premium and mispricing effect conditional on investor sentiments.

5.7 | Other considerations

In the Supporting Information Table OA5, we show the benefit of using absolute EUE, which enables us to capture the ambiguity premium and the mispricing effect more clearly in the line

[41]Investor sentiment is measured using the index by M. Baker and Wurgler (2006), taken from: http://people.stern.nyu.edu/jwurgler/ (accessed in July 2021).

TABLE 11 Portfolio returns in high- and low-sentiment periods

The table reports the risk-adjusted on five MIS (EUE) and 25 EUE–MIS value-weighted portfolios following high- and low-sentiment periods in Panels A and B, respectively. The 25 portfolios are formed by independently sorting on EUE and the mispricing scores. The mean of five MIS (EUE) portfolios is reported in the Average MIS (EUE) column (row). The five MIS (EUE) portfolios are formed by sorting individual stocks on their mispricing scores (EUE), reported in the univariate MIS (EUE) column (row). The risk-adjusted returns are estimates of alphas estimated by the following model: $R_{p,t} = \alpha_H d_{H,t-1} + \alpha_L d_{L,t-1} + \beta_{p,1} MKT_t + \beta_{p,2} SMB_t + \beta_{p,3} HML_t + \beta_{p,4} UMD_t + \beta_{p,5} IA_t + \beta_{p,6} ROE_t + \varepsilon_{i,t}$, where $R_{p,t}$ is the excess return of portfolio p in month t. $d_{H,t-1}$ and $d_{L,t-1}$ are dummy variables indicating the following high- and low-sentiment periods reported in Panels A and B, respectively. MKT_t, SMB_t, HML_t, UMD_t, IA_t and ROE_t are Fama and French market factors in month t. Variable definitions are listed in Appendix A. Portfolio returns are in percent and t statistics are reported in parentheses using Newey and West (1987) robust standard errors with three lags. The sample period is from July 1968 to December 2018. If the value of the sentiment index by M. Baker and Wurgler (2006) in month t is positive (negative), month t is high (low) sentiment month. There are 332 high and 274 low-sentiment months, respectively. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

	Low EUE	2	3	4	High EUE	High–low	Average MIS	Univariate MIS
Panel A: High-sentiment period								
1 Overpriced	−0.24*	−0.11	−0.48***	−0.46***	−0.75***	−0.50**	−0.41***	−0.35***
	(−1.70)	(−0.71)	(−3.23)	(−3.14)	(−4.55)	(−2.20)	(−4.94)	(−4.08)
2	0.01	0.13	0.06	0.06	0.04	0.03	0.06	0.04
	(0.09)	(1.01)	(0.46)	(0.44)	(0.26)	(0.16)	(0.96)	(0.58)
3 Non-mispricing	0.01	0.02	−0.00	−0.01	0.18	0.17	0.04	0.01
	(0.09)	(0.11)	(−0.04)	(−0.08)	(1.28)	(1.00)	(0.73)	(0.20)
4	0.01	−0.01	−0.11	−0.14	0.09	0.09	−0.03	−0.06
	(0.08)	(−0.14)	(−0.95)	(−0.93)	(0.50)	(0.37)	(−0.54)	(−1.07)
5 Underpriced	−0.01	0.14*	0.09	0.25*	0.52***	0.53**	0.20***	0.09*
	(−0.05)	(1.71)	(0.90)	(1.95)	(2.68)	(2.48)	(3.27)	(1.72)
Underpriced−Overpriced	0.24	0.25	0.57***	0.71***	1.27***	1.03***	0.61***	0.44***
	(1.44)	(1.35)	(3.12)	(3.73)	(4.82)	(3.45)	(5.02)	(3.76)

(Continues)

TABLE 11 (Continued)

	Low EUE	2	3	4	High EUE	High–low	Average MIS	Univariate MIS
Average EUE	−0.04	0.03	−0.09	−0.06	0.02	0.06		
	(−0.76)	(0.56)	(−1.60)	(−0.89)	(0.21)	(0.51)		
Univariate EUE	−0.00	0.10*	−0.05	−0.00	0.01	0.01		
	(−0.02)	(1.81)	(−0.80)	(−0.00)	(0.06)	(0.05)		
Panel B: Low-sentiment period								
1 Overpriced	−0.35**	0.03	−0.54***	−0.37**	−0.15	0.19	−0.28***	−0.29**
	(−2.46)	(0.18)	(−2.72)	(−2.20)	(−0.97)	(0.97)	(−2.61)	(−2.57)
2	−0.16	−0.23*	−0.09	−0.17	0.20	0.36*	−0.09	−0.13*
	(−1.22)	(−1.74)	(−0.77)	(−1.29)	(1.17)	(1.65)	(−1.37)	(−1.76)
3 Non-mispricing	−0.33***	0.11	−0.13	0.20	0.25	0.58**	0.02	−0.05
	(−3.07)	(0.88)	(−1.19)	(1.48)	(1.21)	(2.50)	(0.30)	(−0.91)
4	0.22**	−0.10	0.11	0.25**	0.17	−0.05	0.13**	0.12**
	(2.22)	(−1.02)	(0.99)	(2.09)	(0.78)	(−0.20)	(2.14)	(2.18)
5 Underpriced	0.03	0.04	−0.03	0.02	0.21	0.18	0.05	0.02
	(0.25)	(0.43)	(−0.28)	(0.16)	(1.17)	(0.88)	(1.04)	(0.38)
Underpriced−Overpriced	0.37*	0.01	0.51**	0.39*	0.36*	−0.01	0.33***	0.31**
	(1.96)	(0.07)	(2.17)	(1.90)	(1.68)	(−0.04)	(2.61)	(2.27)
Average EUE	−0.12**	−0.03	−0.14**	−0.01	0.13	0.25*		
	(−2.36)	(−0.51)	(−2.33)	(−0.20)	(1.22)	(1.86)		
Univariate EUE	−0.03	0.03	−0.08	0.06	0.19	0.22		
	(−0.63)	(0.69)	(−1.48)	(0.78)	(1.57)	(1.50)		

Abbreviations: EUE, economic uncertainty exposure; MIS, mispricing score.

with theoretical arguments. Particularly, it demonstrates a symmetric impact of the most negative and most positive MEU betas on mispricing. The analysis confirms that using the absolute value of the coefficient would simplify the interpretation of results and enable us to identify the ambiguity premium that would not be able to be observed when using the raw signed coefficients.

Another consideration is the long-term predictive power of the EUE on both effects. In our Supporting Information, we show that, in the FF-6 model, the EUE mispricing effect persists in future five months (alphas of each of the next 12 months are studied). The ambiguity premium does not show persistence at all. By contrast, when the mispricing is accounted for by models, such as q5, there is little sign of mispricing but a strong presence of the ambiguity premium up to 11 future months (see results in Table OA.9 and Figure OA.1 in the Supporting Information). These analyses further confirm that EUE's role in mispricing is mainly amplifying the existing mispricing, which can be explained by more elaborated asset-pricing models. However, the ambiguity-premium effect is strong and clearly quantifiable when mispricing effects are fully controlled for.

6 | CONCLUSIONS

We revisit the role of economic uncertainty in cross-sectional asset pricing. We unify two main channels of the impact, ambiguity premium and mispricing, in a framework of cross-sectional analyses. The foundation of our conjecture is to recognise heterogeneity among investors. Economic uncertainty would affect some investors' demand for compensation for ambiguity aversion and also other investors' biases in evaluating firm characteristics in cross-sectional pricing. Empirically, we separate these two effects by interacting our EUE with an aggregate mispricing measure by Stambaugh et al. (2012).

We show that the observed EUE effect will not simply be positive or negative but depend on the combination of a demand for an ambiguity premium and the stocks' other mispricing characteristics. This evidence could be a starting point for further theoretical development of a unified risk premium and mispricing model. The robustness of our finding of a positive ambiguity premium, which is different from other firm-level mispricing characteristics, suggests that EUE is a good candidate as an additional risk factor, which can be used to explain and predict cross-sectional stock returns. Our findings also have direct practical implications on the attribution of return on investment strategies.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data used in this study are available from different resources. The data on stock market information, accounting information, analyst forecasts information and institutional ownership information are available from the Center of Research in Security Prices (CRSP), Compustat, I/B/E/S and Thomson/Refinitive via Wharton Research Data Service (WRDS), respectively. Further data used this study were derived from the following resources available in the public domain: the economic uncertainty index (https://www.sydneyludvigson.com/macro-and-financial-uncertainty-indexes), the economic policy uncertainty index (https://www.policyuncertainty.com/), mispricing scores (http://finance.wharton.upenn.edu/%7Estambaug/

), equity risk factors (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html) *q* factors (http://global-q.org/factors.html), the market-wide investor sentiment index (http://people.stern.nyu.edu/jwurgler/); the survey of professional forecasters (https://www.philadelphiafed.org/research-and-data/real-time-center/survey-of-professional-forecasters), the variance risk premium factor (https://sites.google.com/site/haozhoupersonalhomepage/), the conditional variance of forecast errors (https://sites.google.com/site/sarahmouabbi/interest-rate-uncertainty?authuser=0).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX A: VARIABLE DESCRIPTION

This table reports details of risk factors and stock-level variables used for the whole study. Panel A reports the details of market risk factors. Panels B and C report the details of firm-level uncertainty exposures and characteristics, respectively.

Variable name	Description
Panel A: Risk Factors	
MKT	The excess market return is the value-weighted return of all firms listed on the NYSE, AMEX and NASDAQ minus the 1-month Treasury-bill rate (Fama & French, 1993).
SMB	Small-minus-big is the average return on the three small-sized portfolios minus the average return on the three big-sized portfolios (Fama & French, 1993).
HML	High-minus-low is the average return on the two value portfolios minus the average return on the two growth portfolios (Fama & French, 1993).
UMD	Winner-minus-loser is the previous 12-month return winner portfolios minus the previous 12-month loser portfolios (Carhart, 1997).
IA	Conservative-minus-aggressive is the difference between the returns on portfolios of stocks with low and high investments (Fama & French, 2015).
ROE	Robust-minus-weak is the difference between the returns on portfolios of the stocks with high and low profitability (Fama & French, 2015).
LIQ	Liquidity is the level of aggregate market liquidity (Pástor & Stambaugh, 2003).
QIA	Investment factor is the difference between the mean returns on the six low I/A portfolios and on the six high I/A portfolios. I/A is the annual change in total assets scaled by the previous year total assets (Hou et al., 2015).
QROE	Profitability factor is the difference between the mean returns on the six low ROE portfolios and the six high ROE portfolios. ROE is income before extraordinary items scaled by previous quarter book equity (Hou et al., 2015).
QEG	The expected growth factor is the difference between the mean returns on two high EG portfolios and the low EG portfolios. EG is the product of operating cash flow-to-assets and the change in ROE (Hou et al., 2021).
MGMT	Management factor is pairwise cross-sectional correlations between stocks in net stock issues, composite issues, accruals, net operating asset, asset growth and investment-to-assets groups (Stambaugh & Yuan, 2017).
PERF	The performance factor is pairwise cross-sectional correlations between stocks in distress, *O*-score, momentum, gross profitability and return on assets groups (Stambaugh & Yuan, 2017).
Panel B: Firm uncertainty exposures	
β^{EUE}	Economic uncertainty exposure is the absolute value of the coefficient of the change of economic uncertainty index (Jurado et al., 2015) estimated by a 60-month rolling regression for each stock with Equation (2).
β^{ADSM}	Macro-disagreement exposure is the absolute value of the coefficient of the change of dispersion in economic forecast estimated by a 20-quarter rolling regression for each stock with Equation (2) by replacing the log change of economic uncertainty index with the log change of those dispersions including GDP, industrial production (INPR) and nonresidential fixed investment (RNRSN) at the growth rates, and unemployment rate (UNEM), Treasury-bill (TBILL) and inflation rate (CPI). Those measures are from the Survey of Professional Forecasters.

(Continues)

Variable name	Description
β^{EPUE}	Economic policy uncertainty exposure is the absolute value of the coefficient of the change of economic policy uncertainty index (S. R. Baker et al., 2016) estimated by a 60-month rolling regression for each stock with Equation (2) by replacing the log change of economic uncertainty index with the log change of the economic policy uncertainty index.
β^{VRE}	Variance risk exposure is the absolute value of the coefficient of variance risk index (Bali & Zhou, 2016) estimated by a 60-month rolling regression for each stock with Equation (2) by replacing the log change of economic uncertainty index with the variance risk index.
β^{ADE}	Ambiguity degree exposure is the absolute value of the coefficient of the change of ambiguity index (Brenner & Izhakian, 2018) estimated by a 60-month rolling regression for each stock with Equation (2) the log change of economic uncertainty index with the log change of the ambiguity index.
Panel C: Firm characteristics	
MIS	Mispricing measure is the mean of decile ranks of a stock based on 11 market anomalies (Stambaugh et al., 2015). These anomalies survive after adjusting for Fama and French's (1993) three factors. Those are accruals (Sloan, 1996), asset growth (Cooper et al., 2008), composite equity issuance (Daniel & Titman, 2006), gross profitability (Novy-Marx, 2013), investment-to-assets (Titman et al., 2004), Distress (Campbell et al., 2008), 12-month momentum (Jegadeesh, 1990) net operating assets (Hirshleifer et al., 2004), net stock issues (Ritter, 1991), *O*-score (Ohlson, 1980) and return on assets (Fama & French, 2006). For each anomaly, the first decile has stocks with the highest abnormal return, while the 10th decile has stocks with the lowest abnormal return. For instance, Sloan (1996) documents that assets with high (low) accruals in the previous year have a low (high) return. Therefore, stocks with the highest (lowest) accruals have the highest (lowest) rank. Then, MIS is formed by computing the mean of each asset's decile rank based on those 11 market anomaly variables (Stambaugh et al., 2015).
β^{CAPM}	Market beta is the absolute value of the coefficient of the market excess return estimated by the market model.
SIZE	Size is defined as the price of the share multiplied by the number of shares outstanding.
BM	Book-to-market is computed as the book value of equity at the end of fiscal year $t-1$ divided by the market value of equity at the end of fiscal year $t-1$.
MOM	Momentum (MOM) is the cumulative return of stock i from month $t-12$ to $t-2$.
REV	Reversal is defined as the stock return at the end of month $t-1$.
COSKEW	Following Harvey and Siddique (2000), it is defined using the following equation: $\frac{E\left[e_t * MKTRF\_DM_t^2\right]}{\sqrt{E\left[e_t^2\right]} * E\left[MKTRF\_DM_t^2\right]}$, where e_t is the residuals from the regression of the daily excess stock return in the market excess return, *MKT*, over the past month. *MKTRF_DM* is the difference between the mean of the daily market excess return and the daily market excess return over the past month.
MAX	It is constructed by taking the average of the five highest return of a stock during a month (Bali et al., 2011).
ILLIQ	Stock illiquidity is defined as the ratio of the daily absolute stock return to the daily dollar trading volume averaged within the month.

Variable name	Description
DISP	Analyst earnings forecast dispersion is measured as the standard value of the mean forecast deviation of long-term earnings forecasts divided by the absolute of the mean forecast.
IVOL	Following Ang et al. (2006), idiosyncratic volatility is defined as the standard deviation of the daily risk-adjusted return residuals computed by regressing each asset's daily return on four Fama and French market factors: *MKT*, *SMB*, *HML* and *UMD*.
ROE	The quarterly operating profitability is computed by income before extraordinary items divided by prior quarter book equity. Quarterly book equity is measured by aggregating shareholders' equity, balance-sheet deferred taxes and investment tax credit if available, minus book value of the preferred stock (Davis et al., 2000).
I/A	The annual growth rate of total assets is calculated by the change in book assets divided by the prior fiscal year book asset (Hou et al., 2015).
TO	Stock turnover is the total trading volume of stock *i* divided by the number of shares outstanding.
IO	Institutional ownership is measured by total institutional ownership divided by shares outstanding, gathered quarterly from 13 F filing on Thomson-Reuters, starting from the first quarter in 1980.