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Research article

Impact of oil price volatility and economic policy uncertainty on business investment - Insights from the energy sector

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ABSTRACT

This research employs a worldwide sample of 4017 energy sector companies from 1996 to 2022 to examine the effects of economic policy uncertainty (EPU) and oil price uncertainty (OPU) on corporate investment in oil/energy sector and this study analyze how market instability and international economic disasters shape the connection between OPU and business assets. GLM regression with firms-years fixed effects and firm-based clustering indicate that both OPU and EPU had a detrimental influence on corporate investment in energy sector. Generalized linear models provide a universal method for addressing various response modeling issues. It is also revealed that oil-producing nations experience OPU and EPU's negative effects more severely than oil-consuming nations. This paper also demonstrates that the link between corporate investment, OPU and EPU is influenced by nations that produce oil, market volatility, and global financial crises. Strong evidence was found supporting the notion that OPU and EPU had a statistically significant detrimental impact on business assets. The findings of the paper are consistent under a variety of robustness tests and show that the association between OPU and EPU and business assets still holds. The results have significant bearing on the asset strategies that company managers and governments should adopt in light of the volatility of oil prices and EPU and this study provide valuable insights for policymakers who are focused on achieving energy transition, enhancing energy security, and meeting environmental goals such as reducing greenhouse gas emissions.

1. Introduction

One of the most fundamental actions taken by corporations is making investment choices, which can impact a company's value and, consequently, the wealth of its shareholders through changes in cost and product differentiation. From a microeconomics perspective [1], argue that the operational performance and intrinsic worth of firms as well as the overall development of the nation's economy, are influenced by the level and efficiency of corporations invest. Various forms of uncertainty, such as political uncertainty, the unpredictability of economic policies, macro uncertainty, production value uncertainty, and input price uncertainty have been discussed in terms of their impact on corporate investment decisions. The uncertainty surrounding them affects the value of a business and a particular investment project. Several theoretical and experimental studies have demonstrated the negative influence of oil price

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uncertainty on business assets [2]. Studies by Refs. [3,4] report a negatively correlation between corporate investment and risk aversion and market uncertainty. Businesses may see a decline in investment as a consequence of increased borrowing costs, risk premiums, and default probabilities brought on by uncertainty [5]. There is an extra degree of unpredictability linked to real options theory and permanent investments [6]. [7] demonstrated that uncertainty stimulates investment by companies under conditions of constant returns to scale and perfect competition. However, another research [8] has shown that companies are hesitant to invest due to the accompanying uncertainty when faced with declining returns to scale or imperfect competition. The relationship between investment and uncertainty has been questioned by other scholars [9]. The volatile price of crude oil, which is used directly or indirectly as a production cost in many industries further complicates investment decisions for businesses. Delaying investments is a common response among companies when they are uncertain about the future [10]. Policy uncertainty has been shown to significantly impact expenses, revenue, and earnings, making it a significantly source of uncertainty.

Improvements in financial strategy can influence firms' operating environments and, therefore, their investment behavior. When investment plans are (at least) partly irreversible, the real options model suggests that economic policy uncertainty (EPU) enhances the value of holding for investment decisions. Businesses sometimes delay investments because more information is needed before making expenditures [11]. While some research supports this notion, others have called into question the relationship between investment and uncertainty. The fluctuating price of crude oil, a significant source of uncertainty in the oil industry, adds further complexity. Dutta et al. [12] have examined the impacts of OPU on investment by companies, using firm-level data from the United States between 1984 and 2017. It has concluded that the negative and asymmetric impact of OPU on investments is most evident among enterprises involved in lubricant and gas production. Specifically, the unpredictability in lubricant prices has a more significant effect for downward movements than upward ones. Other research has focused on the impact of OPU on oil and gas assets demonstrating that changes in oil prices significantly impact both the aggregate and individual investment choices of businesses [13]. Given the interrelated nature of OPU and economic policy uncertainty (EPU), it is crucial to examine the effects of both on business assets, with a particular emphasis on enterprises operating in the oil industry. EPU shock shave led to a slowdown in oil production worldwide, as shown by previous studies [14]. Additionally, oil price shocks caused by rising demand can contribute to increase EPU in countries such as China. Moreover, the interdependency index has indicated a rise in the interconnectedness between macroeconomic uncertainties since 2003. Most micro-level uncertainty at the company level are linked to both OPU and EPU, further emphasizing the need to consider both sources of uncertainty in a unified framework. By studying the influence of volatile crude oil prices and EPU on business investment decisions within the oil industry, we gain valuable insights into how companies adapt their investment strategies in the face of these two distinct types of uncertainty.

To address these issues, we expand on the research conducted by Ref. [15] and investigate the effect of volatile oil prices and EPU on business investment decisions within the petroleum industry. We also explore whether the effects of OPU and EPU differs between oil-importing and oil-exporting nations, between periods of higher and lower market unpredictability, and during the Asian and international economic crises compared to the non-crisis years. Additionally, we examine whether fluctuations in markets and economic crises increases/decreases the influence of economic policy uncertainty and oil price uncertainty on business assets. Recently empirical research, including studies from China and the US has examined the impact of OPU on investment in the oil industries of both nations [16]. However, these studies did not distinguish between oil-importing and oil-exporting countries. It is important to investigate whether the unpredictability of oil prices affects business investment in the oil industry, considering the varying effects of oil price shocks on stock market based on a country's status as an exporter or importer of oil or as a producer of oil. Our study includes a total of 4017 oil industry firms, with 2126 coming from oil exporting nations and 1891 from oil-importing nations. The dataset covers the years 1996–2022, resulting in 44516 observations. Our findings demonstrate that OPU and EPU have similar negative effects on business investment. To assess the generalizability of these adverse impacts, we divided our dataset into six subsets depending upon net lubricant output, market unpredictability, and economic crisis periods. We established that the detrimental effects of OPU and EPU hold across all sample subsets. Additionally, oil-producing countries are particularly vulnerable to the adverse effects of OPU. We also discovered that market fluctuations and economic crises strongly impact the connection amid corporate investment and economic policy uncertainty.

This study is the first to investigate how Oil Price Uncertainty (OPU) and Economic Policy Uncertainty (EPU) affect the likelihood of corporate investment. It examines 18 countries and tests three hypotheses: that OPU increases capital expenditures, that EPU decreases investment, and that both OPU and EPU hurt business assets. The results are consistent across subsamples, suggesting that countries with large oil reserves are more vulnerable and that the effects are negative across sectors, not just in the oil industry. Our research contributes in several ways. First, we find that OPU significantly influences the business asset choices in the oil industry. We included a sample of 4017 businesses from 17 countries, expanding the analysis beyond the two countries examined in Ref. [17]. The present study delves into diverse sub-samples that are categorized based on a country's net petroleum production, market fluctuations, and crisis period. The aim is to ascertain the collective impact of lubricant value indecision and EPU on business investment. Additionally, we analyze how market instability and international economic disasters shape the connection between OPU and business assets. Our findings provide new evidence on the detrimental impact of EPU on business investment, contributing to existing research on the topic [18]. suggest that the severity of market unpredictability and economic disasters affects the strength of the association. Our study builds upon their work by demonstrating that OPU and EPU on business assets are significantly impacted by factors such as a nation's net oil output, and market unpredictability. Finally, previous research on the effects of EPU on investment has predominantly focused on either developed or emerging economies. However, our research analyses this link within oil industry, considering both developed and emerging nations. The rest of the paper includes the literature review and hypothesis formulation in Section 2, the explanation of the study's variables and sample size in Section 3, the summary of key results and robustness tests in Section 4, and the conclusion in Section 5.

2. Literature review

2.1. Dynamics of oil price uncertainty

Oil price fluctuations affect the economy and financial markets via a transmission mechanism known as the uncertainty channel [19]. The fluctuations in oil prices make both businesses and consumers more hesitant to make investment and consumption decisions. cyclical fluctuations in collective investment stem from businesses' lack of clarity over the return on investment (ROI), for instance, due to fluctuations in energy prices [20]. Initial investigations on the impact of oil prices on market performance found contradictory findings [21]. As most of the research have shown oil price shocks harm stock market performance [22]. However, other studies have presented contrary findings suggesting that oil prices either positively impact stock market returns or that there is no tangible link between the two sectors [23]. There are two possible explanations for the divergent findings regarding the direction of the effect. First, nations that import and export oil may experience the impact of crude oil on the stock market in opposing directions. Second, the oil-stock relationship is time-varying, and previous studies failed to account for the dynamic changes in the petroleum price drivers and regional economic frameworks [24]. Several studies have found that the connections between oil price shocks and corporate investments are time-varying and nonlinear, with economic fluctuations influencing oil-stock correlations [25]. Techniques such as the GARCH framework, wavelet breakdown, copula, and time domain evaluation have been used to analyze the oil price shocks and corporate investment. Oil price shocks-investment correlations are affected by financial shocks and extreme events caused by geopolitical tensions or national macro policies. The first Iraq War in 2003 and the Iraqi Civil War in 2005 significantly impacted the oil-investment nexus. Similarly, in China the oil-investment nexus underwent dynamic changes after the 2013 revision of the country's refined oil pricing [26]. Understanding the impact mechanism of lubricant price shocks at the sector level is important because industry investments include different options in the investment portfolios. Moreover, while some studies have focused on shorter-run oil-investment correlations, only a few have investigated the impact of macroeconomic variables on long-run correlations. Long-term correlations may provide insight into the predicted correlation for specific economic scenarios. Economic strategies and marketplace structure, closely tied to the state financial landscape are two macroeconomic drivers influencing cross-market long-term correlations [27]. However, there is limited research on what exactly causes the oil-investment nexus for a long-term correlations and how economic policy EPU could affect those relationships.

H1. Uncertainty over the price of crude oil considerably lowers business investment.

2.2. The marketplace's reaction to the lack of clarity about economic policy

After the global financial crisis of 2008, the worldwide market remained turbulent, leading to increased EPU. Consequently, much attention has been given to understanding how EPU affects the economy. Several initial studies examined the impact of EPU on stock market returns and volatility [28]. The key findings from this research are as follows: First, based on theoretical assumptions, most studies have demonstrated that EPU harms stock market returns. Second, the magnitude of this impact varies over time and is linked to the prevailing monetary policy climate. Greater economic policy uncertainty results in a more significant decline in stock market returns; the impact of EPU is more prominent and enduring during periods of significant stock market volatility. In recent years, academics research has arrived a threefold conclusion regarding the relationship between policymaking and asset market volatility during the last several years. Firstly, an increase in EPU has been associated with higher stock market volatility [29]. Secondly, EPU has been identified as a crucial factor in determining long-term stock market volatility [30]. These studies heavily rely on the GARCH-MIDAS model, which allows for a comprehensive examination of both long-term trends and short-term volatility in the stock market by effectively separating the former from the latter and identifying the macroeconomic factors influencing the latter. Third, EPU is more likely to contribute to frequent stock market volatility during economic downturns [31]. Beside the stock market, studies have emerged in recent years examining the impact of EPU on foreign currency markets, bond markets, gold markets, and the market for digital currencies. These investigations consistently demonstrate that EPU significantly contributes to asset volatility. Due to commodity, financial, and geopolitical characteristics, crude oil's supply and demand are also susceptible to EPU, suggesting that EPU can be used to anticipate oil market volatility [32].

H2. Corporate investment is substantially reduced by uncertain economic policies.

3. Methodology

Generalized Linear Models (GLMs) is used in this research because it has significant importance in the field of statistics and data analysis due to many reasons. These are a versatile framework that expands upon the standard linear regression model to handle several kinds of response variables. GLMs are well-suited for a diverse array of practical applications. These methods are often used accurately in the analysis of data obtained from experiments, observational studies, and surveys. GLMs, unlike simple linear regression, enable the modeling of response variables that adhere to non-normal distributions. Moreover, GLMs are especially advantageous for analyzing count data, binary data, or skewed continuous data. These models have the ability to effectively manage data that exhibits heteroscedasticity, meaning there is uneven variation across different groups or levels of predictors. Additionally, GLMs are capable of addressing non-constant error variance, which is a prevalent problem in real-world datasets. GLMs can provide robust parameter estimates by selecting a suitable error distribution and link function. Furthermore, they provide a clear and precise interpretation of coefficients, which is comparable to that of regular linear regression. This facilitates the transmission of data to

audiences without statistical expertise and enables the derivation of significant conclusions from the research.

GLMs provide the means to do hypothesis testing, estimate confidence intervals, and pick models. This enables us to draw accurate statistical conclusions about the associations between predictors and the response variable. They enable the inclusion of intricate links between predictors and the response variable by selecting suitable link functions. This allows for the representation of non-linear connections, interactions, and other intricate patterns within the data.

3.1. Details of dataset

The data section based on energy-specific knowledge is essential for fully grasping how oil price volatility and economic policy uncertainties affect company investment in this field and the dataset used in our research includes the oil price, detailed financial and accounting information on individual companies, national Growth rate, and the EPU index. Oil statistics were obtained from "the US Energy Information Administration (EIA)."

i) Data Stream was utilized to gather the accounting and financial information, while the World Bank data base provided each nation's GDP growth rate. The EPU index was employed to measure financial policy uncertainty in each country.
ii) An imaginary variable was introduced to capture periods during the financial crisis. Detailed information about the research parameters can be found in the Appendix. The sample consists of 4017 oil industry enterprises from 18 nations, with a total of 44,516 firm-year data spanning the years 1996–2022.
iii) To mitigate the impact of outliers, the data was winsorized by removing the top and bottom 5% from each country's dataset before conducting the analysis.

The primary sample was then divided into six subsamples based on whether a country was a net oil exporter or importer, whether it experienced the Asian (1997) or global (2007–2009) financial downturns, and whether it was a period of significant market volatility. Following the work of [33], we categorized our data set into fuel-producing and fuel-consuming nations. Oil-consuming nations are classified by the EIA as those with fuel consumption exceeding output, while oil-producing nations produce more oil than they consume. Grounded on this categorization, our sampling comprises of 2126 companies representing oil-exporting nations and 1891 representing oil-importing nations.

This differentiation is important as evidence from Ref. [34] suggests that the impact of oil pricing uncertainties varies significantly across these two types of nations. Furthermore, while [35] categorize all non-financial sector businesses, we differentiate between oil industry corporations based on whether they operate in oil-producing or oil-consuming nations. Additionally, previous literature indicates that market uncertainty influences a company's investment decisions. Hence, we aim to investigate whether the impact of the EPU and OPU differs with market fluctuations. For example, businesses operating in highly turbulent markets may react differently than those in less volatile environments. Finally, the sample is further divided into subsamples representing periods of financial crisis and non-crisis years. Financial crisis years, such as the Asian catastrophes in *1997* and the international economic catastrophe in *2007 to 2009*, are given a number of 1, while non-crisis years are assigned a value of 0. The MSCI World Index serves as a proxy for the global stock market. A value of 1 for the market volatility dummy indicates that the variation of daily returns over the last year has been greater than the sample median. Fig. 1 shows the relationship between EPU and OPU from 1996 to 2022.

3.2. Evaluation of factors

The ratio of capital expenditures to total resources is used as the dependent variable in our sample. Both "OPU and EPU" are

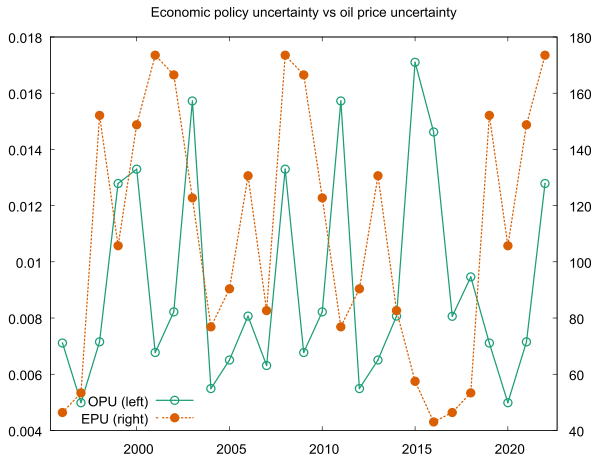

Fig. 1. Relationship between global EPU and OPU from 1996 to 2022.

employed as explanatory variables. The volatility of oil prices is calculated by using the "standard deviation of daily returns on fuel", a method utilized by previous authors such as [36]. Following the existing literature, we determined the unpredictability of oil's value using the following formula in Eq. (1):

$$\sigma_t = \sqrt{\frac{1}{N-1}\sum_{t=1}^{N}\left(r_t^0 - Er_t^0\right)^2}.\sqrt{N} \tag{1}$$

To calculate EPU, we utilized fourth sub-indices, including Consumer price index prediction difference measure, central/national/local purchasing difference measure and the tax expiration index. Our independent variables included "leverage, firm size (SIZE), sales growth rate (GROWTH), Tobin's Q, logarithm of GDP (LnGDP), and cash flow". Leverage is defined as the ratio of total debt to total assets, and firm size is the natural logarithm of total capital. The growth in sales rate (GROWTH) is determined by dividing the percentage increase in sales over the previous years' total sale. To mitigate potential bias from a significant GDP figure, we utilized the natural logarithm of gross domestic product growth. Operating cash flow is divided by total assets to obtain the cash flow figure. The data demonstrate significant fluctuations in business investment throughout the analyzed period. Moreover, both OPU and EPU exhibit fluctuations over the covered time frame. The graphs reveal that business investment generally increased during periods of lower EPU and oil price uncertainty. Conversely, business investment declined during periods of higher EPU and oil price uncertainty.

3.3. Indicators of description

The descriptive statistics for our sample are presented in Table 1. The independent variables in our analysis are: "The level of investment (INV), the volatility of oil prices (OPU), the degree of uncertainty surrounding economic policy (EPU)." On the other hand, the control variables are: "The leverage ratio (LEV), Operational cash flow (CF), Firm size (SIZE), Sales growth (GROWTH), Tobin's (Q), Gross domestic product (GDP)." The detailed explanations of these variables are given in Appendix A.

The fluctuations in oil prices may significantly impact macroeconomic factors, including inflation, GDP growth, and employment. Elevated oil prices might result in escalated production expenses for enterprises, thus impeding economic expansion and exacerbating inflationary forces. In contrast, decreased oil prices may invigorate economic activity by diminishing expenses for firms and decreasing transportation costs for consumers. Gross Domestic Product (GDP) is a fundamental indicator of a nation's economic success. It quantifies the overall monetary worth of all commodities and services generated within a country's boundaries within a certain timeframe, often on an annual or quarterly basis. Gross Domestic Product (GDP) growth measures the pace at which a nation's economy is either increasing or shrinking. Positive GDP growth signifies an increase in economic activity, whilst negative growth implies a decrease in economic activity.

Uncertainty in oil prices impacts investment choices in several areas, such as energy, manufacturing, transportation, and finance. Uncertainty over forthcoming oil prices might result in postponements or alterations in investment strategies, as enterprises may exhibit reluctance to allocate funds to ventures that are susceptible to fluctuations in energy costs. During times of extreme price volatility, corporations may choose to postpone investments in oil exploration and production projects.

The uncertainty around oil prices has a direct impact on consumer behaviour, since it influences how consumers spend their money and make purchase choices. Elevated oil prices may result in increased costs for fuel, heating oil and other goods derived from petroleum, so diminishing customers' expendable income and possibly suppressing consumer expenditure on non-essential commodities. In contrast, decreased oil costs might enhance customers' ability to buy, resulting in heightened expenditure on products and services.

Cash flow refers to the net cash inflows or outflows resulting from a company's operational activities within a certain timeframe. Positive cash flow signifies that a corporation is producing a surplus of cash compared to its expenditures, whilst negative cash flow implies a shortfall of cash. Cash flow is a crucial metric that reflects both the financial well-being and operational effectiveness of a firm. A robust and favorable cash flow signifies that a corporation is capable of fulfilling its financial commitments, pursuing expansion prospects, and enduring economic downturns.

Gross Domestic Product (GDP) is a fundamental indicator of a nation's economic success. It quantifies the overall monetary worth of all commodities and services generated within a country's boundaries over a certain time frame, often on an annual or quarterly basis. GDP growth is a measure of the pace at which a nation's economy is either increasing or declining. Positive GDP growth signifies

Table 1
Indicators of description.

Variables	N	MEAN	Standard Deviation	Minimum	Median	Maximum
INV	44,517	2.296	3.361	1	1.194	0.976
OPU	44,517	2.291	3.359	1.114	2.392	0.183
EPU	4301	2.392	3.399	2.231	2.381	7.607
LEV	40,608	2.381	3.401	1	3.326	0.686
SIZE	40,608	13.392	4.445	7.761	12.22	19.18
GROWTH	35,116	1.4	4.488	−7.700	2.251	3.241
Q	35,116	3.399	6.637	1	3.329	0.87
CF	35,116	−3.311	6.526	5.613	3.245	0.248
GDP	35,116	5.506	6.543	−8.730	3.33	19.18

an increase in economic activity, whereas negative growth implies a decrease in economic activity.

The leverage ratio, or debt-to-equity ratio, quantifies the extent to which a company's debt compares to its equity capital. The metric signifies the degree to which a corporation depends on borrowing money to finance its activities and developments. A high leverage ratio indicates that a corporation is more exposed to financial risk, since excessive debt may lead to higher interest expenditures, increased financial susceptibility, and a greater likelihood of default, especially during economic downturns or times of financial difficulty.

4. Results and analysis

4.1. Univariate study

The findings from the univariate study comparing corporate investment during high volatility in oil prices and low economic policy uncertainty (EPU) are presented in Table 2.

The univariate study compares corporate investment during periods of high lubricant price uncertainty (Panel A) and low lubricant price uncertainty (Panel B). In high volatility periods, when the oil prices volatility exceeds the sample median, we observe high uncertainty. Conversely, when the oil price volatility is below the sample median, it is considered a low oil price uncertainty era. The univariate analysis of EPU levels during times of high and low EPU is shown in panel B of the table. The term "High EPU" denotes those years in which the EPU surpasses the median value of the sample period, whereas "Low EPU" pertains to those years in which the EPU falls below the median value of the sample period. The t-statistics provide a measure of the statistical significance of the observed difference between the two samples, specifically the high sample and the low sample. The findings presented in Table 2 show that when OPU is above its median, indicating increased volatility in crude oil prices corporate investment decreases. Conversely, during periods of low uncertainty, corporate investment increases. Similar outcomes are observed for high and low EPUs. Uncertainty levels for EPU were also determined similarly. In columns 2 and 3, you'll find the average investment values for higher OPU and lower OPU scenarios, respectively. In columns 4 and 5, there is a difference in corporate investment between lower and higher OPU and the t-value of that variance. Based on our findings, it is clear that in panel A, corporations spend less during high OPU and more during low uncertainty. Both the high and low EPUs yield similar outcomes. Adverse and statistically significant factors are found for the variance between higher and lower uncertainty periods for OPU and EPU. Our preliminary findings confirm that rising crude oil price volatility discourages business investment in the petroleum sector.

4.2. Primary outcomes

4.2.1. Uncertainty about the price of oil and business investment

The initial findings from our univariate research suggest an adverse and statistically significant correlation between OPU and business investment in the petroleum sector. However, it is important to consider additional factors and variations across businesses that may impact business investment. To address this, research conducted a multivariate regression analysis following a commonly used technique in prior research [37].The regression equation we employed is as follows in Eq. (2):

$$INV_{i,t} = \alpha + \beta_1 OPU_{t-1} + \beta_2 Lev_{i,t-1} + \beta_3 Size_{i,t-1} + \beta_4 Growth_{i,t-1} + \beta_5 Q_{i,t-1} + CF_{i,t-1} + \beta_7 GDP_{t-1} + \varepsilon_{i,t} \quad (2)$$

In Equation (2), the variables i represents firms and t shows time, correspondingly. The variable of interest is the dependent variable, namely corporate investment (INV). INV is derived by dividing the capital expenditure of the preceding year by the total assets. The independent variable of our study incorporates the daily returns of the standard deviation of crude oil volatility, denoted as OPU.

Table 2
Univariate study.

Panel A : OPU	**Low Uncertainty**	**High** Uncertainty	Differences	**t − Statistics**
Global	3.384	1.1468	−1.137***	−3.38
OPC	4.454	1.196	−1.158***	−3.30
OCC	4.415	4.498	−1.116**	−3.34
High Volatility	4.496	4.457	−1.138***	−5.57
Low Volatility	4.458	4.429	−1.129*	−5.56
Financial distress period	4.417	5.484	−1.133**	−5.47
Non − distress periods	5.477	4.438	−1.139***	−6.68
Panel B : EPU	**Low EPU**	**High EPU**	Differences	**t − Statistics**
Global	1.191	4.421	−1.168***	−14.46
OPC	1.105	4.434	−2.271***	−14.49
OCC	1.268	4.445	−2.223***	−6.67
High Volatility	2.204	4.43	−2.274***	−16.61
Low Volatility	2.254	4.421	−2.233*	−6.64
Financial distress period	4.454	4.404	2.250***	−5.41
Non − distress periods	4.489	4.407	−2.281***	−14.41

Furthermore, we employed customary control variables as per the existing literature. Lev represents the leverage ratio, which is the amount of liability relative to the value of the company's asset. Growth indicates the percentage increase in revenue over the previous year, and Size is the natural logarithm of total assets. Tobin's q (Q) is determined by dividing the market price of properties by their book value. CF represents the cash flow, calculated by multiplying operational cash flow by total assets. To account for national economies, we incorporated GDP growth rate. To account for serial correlation in the data, we employed a common practice in the literature by clustering the standard errors at the corporation level. Additionally, we incorporated firm and year fixed effects into the model, known as panel fixed effect, to further address the issue. The results of Equation (1) on the impact of OPU on business investment are presented in Table 3. Column 1 displays the primary regression findings for the global sample of oil value unpredictability and business investment. However, we conducted a more granular analysis by dividing the sample into six sub-samples, and the corresponding outcomes are presented in columns 2 through 7. Columns 2 and 3 exhibit the results for the sample of nations that produce and consume oil, respectively. Columns 4 and 5 illustrate the outcomes for countries with high and low market unpredictability, respectively.

Table 3 provides corroboration of the results obtained from the univariate analysis. The coefficients that were observed demonstrate a consistent negative trend and are statistically significant. The findings suggest that an increase of one percentage point in crude oil uncertainty is related with a decline of 1.55% in corporate investment, as evidenced in the complete sample (first column). The impact of crude oil price volatility on business investment has been noted to be adverse in nations that produce and consume oil. However, it has been noted that the impact is more prominent in oil-producing nations. A 1% rise in OPU results in a 3% reduction in business investment for oil-producing nations and a 0.60% reduction for oil-consuming nations. Columns 5 and 6 of Table 3 provide detailed findings for high and low volatility periods, respectively. The end product is quite impressive. The coefficient exhibits a statistically significant and negative value. In times of heightened volatility, it can be observed that oil industry firms tend to reduce their investment activities in response to unfavorable market conditions, as indicated by the negative and statistically significant coefficient. The present findings are consistent with prior research that has demonstrated a more pronounced adverse association between OPU and corporate investment in times of market volatility [38].Conversely, during low volatility, the constants are positive and statistically significant indicating that companies increase their investments. The last two columns of Table 3 examine the sample during times of financial crisis and times of economic stability. Interestingly, the constants are consistently negative and statistically significant. However, during economic difficulty, a 1% rise in crude oil uncertainty leads to a1.44% drop in business assets, compared to a 0.38% decline during the times of the economic stability. The findings support the notion that companies exercise caution and opt to wait during periods of high OPU when making investment decisions [39].It suggests that companies prefer to limit their investment during periods of high OPU.

4.2.2. *Enterprise-wide investing and EPU*

By substituting the EPU factor for OPU in Equation (1), we can experimentally test our second hypothesis that EPU negative effects company investment as in Eq. (3).

Table 3
GLM regression analysis.

	1	2	3	4	5	6	7
OILVOL	−3.350*** (−2.23)	−2.205*** (−1.11)	−3.396* (−3.36)	−5.543*** (−5.53)	4.452** (3.22)	−1.225*** (−1.163)	−2.278*** (−2.224)
LEV	1.157*** (4.43)	1.101*** (1.12)	1.182*** (3.26)	5.556*** (5.52)	4.417*** (4.42)	1.144 (2.240)	−2.230 (−2.217)
SIZE	−4.411*** (−14.41)	−1.112*** (−6.62)	−1.108*** (−2.23)	−5.510*** (−15.50)	−4.413*** (−4.45)	2.234*** (2.262)	2.211*** (2.113)
GROWTH	1.148*** (35.53)	6.667*** (36.64)	1.131*** (21.11)	5.547*** (35.52)	4.457*** (4.44)	2.226*** (2.112)	1.149*** (22.213)
Q	−1.163*** (−5.54)	6.638*** (−6.61)	−1.137* (−5.54)	−5.564*** (−5.58)	−4.427 (−4.46)	2.240 (2.291)	−1.111 (−1.294)
CF	1.162*** (23.30)	3.356*** (13.33)	5.509*** (15.52)	4.456*** (24.8)	4.438*** (4.47)	1.107*** (2.269)	5.514*** (15.590)
GDP	1.101 (3.37)	−3.313*** (−3.34)	−3.301 (−3.32)	4.401 (4.48)	6.601 (6.69)	5.507*** (5.514)	−5.501 (−5.575)
Constant	2.222*** (22.27)	3.361*** (13.34)	3.232*** (13.33)	4.445** (4.48)	6.634*** (6.64)	−5.599 (−5.540)	6.658*** (6.686)
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Firm FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R^2Within	1.00	1.00	1.00	1.00	1.00	1.00	1.00
R^2between	1.00	1.00	1.00	1.00	1.00	1.00	1.00
R^2overall	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Observation	35,067	16,362	18,708	33,108	1962	6892	28,185

Note: The presented table exhibits the application of GLM regression in examining the link amid oil price volatility and business investment, while controlling for fixed effects of firms and years. The factor that is contingent on another is referred to as the dependent variable, while the variable that is not influenced by any other is known as the independent variable. In this particular case, corporate investment is the dependent variable, while the OPU is independent variable. Table 1 and the Appendix provide a comprehensive description of all variables utilized in the analysis. The t-statistics' significance level is enclosed in brackets, and the symbols*, **, and *** denote significance levels of 10%, 5%, and 1%, respectively.

$$INV_{i,t} = \alpha + \beta_1 EPU_{t-1} + \beta_2 Lev_{i,t-1} + \beta_3 Size_{i,t-1} + \beta_4 Growth_{i,t-1} + \beta_5 Q_{i,t-1} + \beta_6 CF_{i,t-1} + \beta_7 GDP_{t-1} + \varepsilon_{i,t} \quad (3)$$

Table 4 presents the results obtained using Equation (2). EPU measures the level of economic policy uncertainty in a nation and has been widely employed in previous researches [40]. Similar to Table 3, we divide the primary sample panel into six subsamples based on factors such as country of origin, market fluctuations, the presence or absence of an economic crisis, and the level of oil consumption. Table 4 presents the outcomes of the Generalized Linear Model analysis examining the relationship between EPU volatility and business investments.

Table 4 shows that most parameter coefficients exhibit negative values and are significantly different from zero, supporting the univariate findings presented in Section 4.1. Notably, only in the case of oil-importing nations do we observe a positive and statistically significant coefficient. The overall panel results are reported in column 1, demonstrate a significant negative effect at the 1% level. Specifically, a 1% increase in EPU leads to a 0.017 percentage decrease in corporate investment. The impact of EP on business assets varies between oil-exporting and oil-importing nations, with the effect being adverse for the former and favorable for the latter. Fig. 2 shows the predicted values of the investment with two variables (OPU and EPU) in comparison when all variables are used for prediction.

In Table 4, columns 5 and 6 present the results during high and low volatility, respectively. Similar to the overall sample, the effect remains negative and significantly different from zero at the 1% level. The last two columns display the findings during times of financial crisis compare to times without financial distress, both of which show adverse effects at the 1% significance level. Table 4 provides evidence that, like "OPU, EPU" generally leads to significant reduction in capital expenditures by businesses. Furthermore, our second hypothesis is confirmed as the findings are consistent in five of six subsamples. These results align with previous research establishing an inverse relationship between EPU and business expenditures.

In order to validate the findings of Table 3, investment forecast is made using investment as dependent variable and all other variables as predictor. Moreover, Fig. 3 represents comparison of investment prediction (fitted vs actual values) using all independent variables vs using only 2 variables (OPU and EPU).

4.3. Further analysis and robustness test

In this section, we conduct additional analyses to determine the robustness of our main findings when altering the baseline variables. It aims to examine the consistency of our results under different conditions, such as variations in the state of financial markets, the severity of the global financial crisis, and the proxies used to measure business investment, petroleum fluctuation, and financial unpredictability.

4.3.1. The marketplace volatility and its impact

The influence of OPU on business spending may be influenced by market fluctuations [41].To examine the relationship between OPU and market volatility on business investment, we introduce an interaction term in our regression model. We also investigate how market volatility affects the association between economic policy uncertainty (EPU) and business expenditures. The regression models

Table 4
Generalized Linear Model analysis examining the relationship between EPU and business investments.

	1	2	3	4	5	6	7
EPU	−3.417*** (−7.89)	−4.469*** (−8.86)	0.015*** (5.17)	−1.116*** (−9.92)	−5.530*** (−7.71)	−6.640*** (−8.843)	−5.591*** (−16.617)
LEV	1.195*** (6.76)	6.722*** (6.678)	6.693*** (8.98)	2.284*** (7.71)	7.727*** (5.5 + 8)	6.681*** (7.742)	−6.605 (−6.655)
SIZE	−2.212*** (−14.41)	−6.716*** (−18.80)	−2.09*** (−9.93)	−4.411*** (−17.73)	−1.121*** (−8.84)	7.742*** (7.768)	7.712*** (8.896)
GROWTH	1.47*** (35.58)	1.166*** (38.84)	1.131*** (27.70)	1.147*** (38.88)	2.253*** (8.81)	7.725*** (8.805)	6.648*** (26.640)
Q	−2.290*** (−6.68)	−5.756*** (−8.85)	−3.354*** (−8.73)	−5.584*** (−8.85)	5.589** (−7.75)	−5.571 (−7.799)	−6.634 (−6.661)
CF	3.466*** (26.61)	7.873*** (19.97)	5.507*** (17.70)	8.860*** (28.85)	4.440*** (6.64)	7.795*** (7.710)	5.409*** (15.538)
GDP	1.100 (1.11)	−8.812*** (−8.80)	−4.401 (−6.672)	7.700 (9.98)	1.105 (5.57)	7.707*** (8.800)	−4.403** (−5.545)
Constant	1.195*** (21.12)	6.751*** (18.72)	5.496*** (9.98)	8.821** (9.96)	4.418*** (6.69)	7.744*** (8.882)	5.559*** (16.59)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2Within	1.00	0.31	0.19	0.33	0.16	0.27	0.25
R^2between	1.00	1.00	1.00	1.00	1.00	1.00	1.00
R^2overall	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Observation	34,253	16,323	17,932	32,632	16,23	67,82	3224

Note: Uncertainty surrounding economic policies was examined using a "generalized linear model (GLM)" with fixed effects for companies and years. The results are presented in the following Table 4. In this analysis, economic policy uncertainty serves as the independent variable, while business investment is the dependent variable. Table 1 and the Appendix provide comprehensive information on the variables analyzed. The significance levels, indicated by t-statistic in the brackets, the significance as 1%, 5% and 10%, based on clustering the residuals at the fixed level.

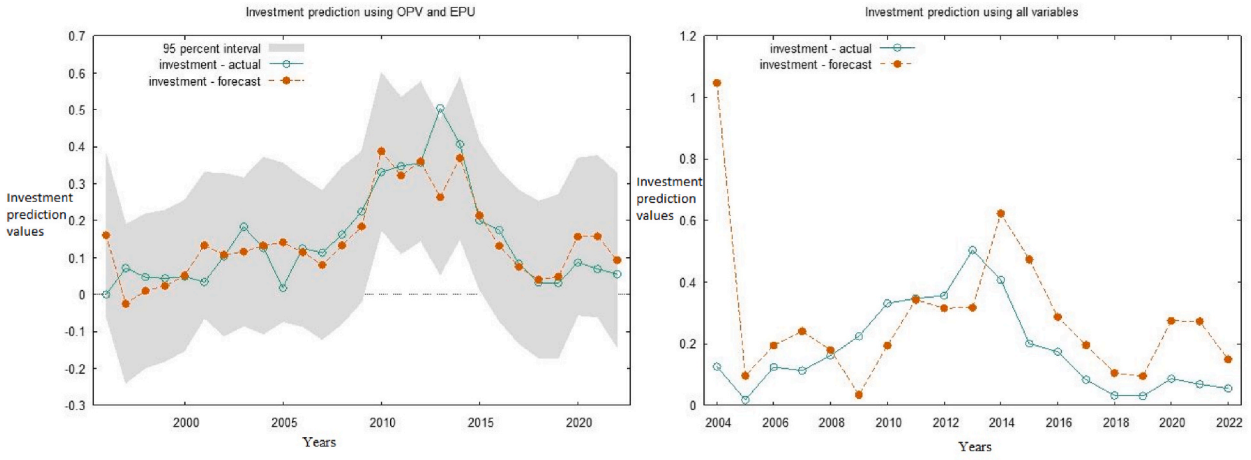

Fig. 2. Comparison of actual investment and forecast at different time frames. Note: The green line indicates the actual global investment and dotted red line indicates the predicted value of investment by. For a perfect prediction (dependent variable 100 percent corresponds to trend in independent variables), both lines should overlap. The plot in fig. 2 shows a considerable accuracy indicating that investment is dependent on all variables including oil price uncertainty and economic policy uncertainty. These findings corelate with the findings in Table 3. When only two variables (OPU and EPU) are used for prediction, Fig. 2 indicates a better response (actual and predicted lines are closer to each other) as compared to the predicted response line when all the variables are used for prediction. These results indicate that OPU and EPU has a closer relation and significantly impact the corporate investments. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

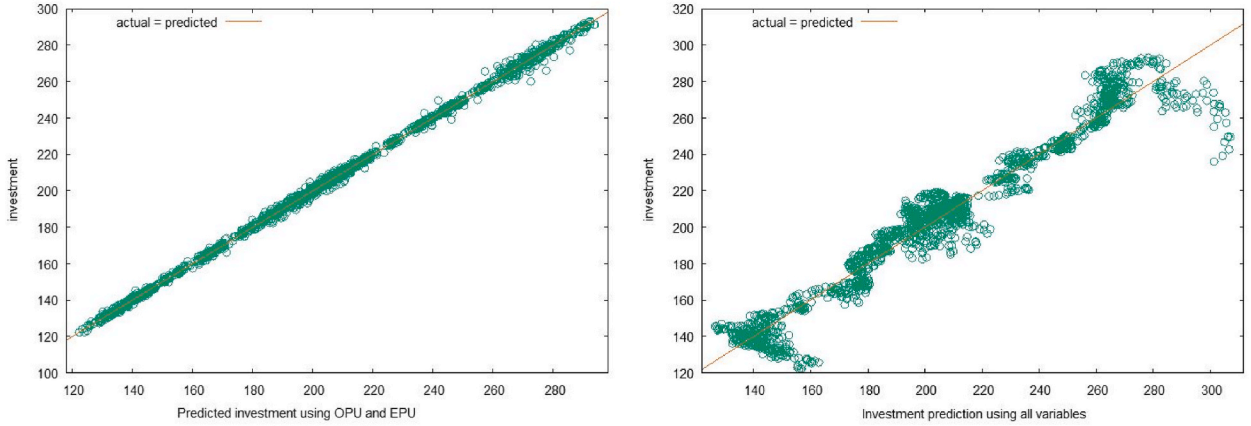

Fig. 3. Comparison of investment prediction using all independent variables vs using only 2 variables (OPU and EPU).Note: The accuracy with which the model predicts response values is seen in Fig. 3. For a perfect regression model, all the data points should lie on the diagonal line because the expected response of a perfect regression line is the same as the actual response. The predicted points that are furthest from the mean, those on the plot's left and right, exert the most strain on the fitted line, trying to pull it to a position away from the diagonal. Points that are far off the vertical center line may be outliers. The fit might be adversely impacted by one of these types of factors. When only two variables (OPU and EPU) are used for prediction, Fig. 3 indicates a better response (all values close to diagonal line) as compared to the predicted response line when all the variables are used for prediction. These results indicate that OPU and EPU has a closer relation and significantly impact the corporate investments.

used to evaluate these hypotheses are as follows in Eq. (4) and Eq. (5):

$$INV_{i,t} = \alpha + \beta_1 OPU_{t-1} + \beta_2 OPU_{t-1} \times VOL_{t-1} + \beta_3 Lev_{i,t-1} + \beta_4 Size_{i,t-1} + \beta_5 Growth_{i,t-1} + \beta_6 Q_{i,t-1} + \beta_7 CF_{i,t-1} + \beta_8 GDP_{t-1} + \varepsilon_{i,t} \quad (4)$$

$$INV_{i,t} = \alpha + \beta_1 EPU_{t-1} + \beta_2 EPU_{t-1} \times VOL_{t-1} + \beta_3 Lev_{i,t-1} + \beta_4 Size_{i,t-1} + \beta_5 Growth_{i,t-1} + \beta_6 Q_{i,t-1} + \beta_7 CF_{i,t-1} + \beta_8 GDP_{t-1} + \varepsilon_{i,t} \quad (5)$$

These formulae are similar to Equation (1) discussed earlier, with the only difference being the interaction term between market volatility (VOL) and OPU or EPU. We use the annualized dispersion of the daily returns of the MSCI World Index as a measure of stock market volatility. If the volatility during a specific period exceeds the sample median, we assign it a value of 1; otherwise, it is assigned a value of 0. The interaction between market volatility and OPU in the first column of Table 5 reveals a negative and statistically significant impact, indicating that the adverse effect of uncertainty in crude oil prices is amplified by its volatility.

Consistent with the findings of [42],column 3 of Table 5 presents findings of joint impact of market unpredictability and EPU. The results indicate that the impact of EPU on business investment is exacerbated by market volatility, implying that the association between EPU and business assets is influenced by market fluctuations.

4.3.2. Financial Crisis's contributing factors

This section explores how the financial crisis influenced the link between EPU and business investment, as well as between the price of oil uncertainty and investment. The following regression models were used to examine these relationships:

Model for OPU as in Eq. (6):

$$INV_{i,t} = \alpha + \beta_1 OPU_{t-1} + \beta_2 OPU_{t-1} \times Crisis_{t-1} + \beta_3 Lev_{i,t-1} + \beta_4 Size_{i,t-1} + \beta_5 Growth_{i,t-1} + \beta_6 Q_{i,t-1} + \beta_7 CF_{i,t-1} + \beta_8 GDP_{t-1} + \varepsilon_{i,t} \quad (6)$$

Model for EPU as in Eq. (7):

$$INV_{i,t} = \alpha + \beta_1 EPU_{t-1} + \beta_2 EPU_{t-1} \times Crisis_{t-1} + \beta_3 Lev_{i,t-1} + \beta_4 Size_{i,t-1} + \beta_5 Growth_{i,t-1} + \beta_6 Q_{i,t-1} + \beta_7 CF_{i,t-1} + \beta_8 GDP_{t-1} + \varepsilon_{i,t} \quad (7)$$

These equations are similar to the previous equations discussed, with the only difference being the interaction of the crisis dummies (taking the value 1 during the sample period of 1997 and 2007–2009, and 0 otherwise) with OPU. The findings for the financial crisis are given in column 2 of Table 5. The results indicate a significant negative relationship at the 1% level. During the crisis period, a 1% upsurge in OPU led to a 0.74% decrease in business investment. This suggest that the financial crisis had a detrimental impact on corporate investment. Additionally, we observed that international economic crises weaken the correlation between EPU and business assets.

4.3.3. Robustness analysis

To ensure the reliability of our findings, we conducted additional experiments using different metrics for business investment, OPU, and EPU. We employed measure business investment: INVALT1, which represents investment expenses divided by assets, and plants

Table 5
Compound impact of market volatility and EPU policy uncertainty on business investment.

	1	2	3	4
OPU	2.257***	−2.276***		
	−2.243	(−1.167)		
VOL − OPU	−2.242***			
	(−2.259)			
Crisis − OPU		−1.144***		
		(−1.168)		
EPU			1.134	−1.177***
			−2.231	(−11.119)
VOL − OPU			−2.219***	
			(−2.243)	
Crisis − EPU				−1.161***
				(−2.283)
VOL	−2.299***		2.263**	
	(−2.297)		−6.623	
Crisis		−1.182**		3.349
		(−1.142)		−3.337
LEV	−0.009	−3.314	1.118	3.318
	(−1.196)	(−3.305)	−1.12	−3.332
SIZE	1.115***	3.314***	1.116***	3.316***
	−1.104	−3.388	−1.154	−3.37
GROWTH	1.147***	3.347***	1.147***	6.647***
	−22.22	−23.384	−21.18	−26.614
Q	−1.113	−3.311	−1.138	−6.639
	(−1.154)	(−3.358)	(−4.413)	(−6.672)
CF	1.113***	3.316***	4.410***	2.111***
	−11.186	−13.392	−15.53	−12.206
GDP	1.102**	3.302**	5.502	2.201
	−1.156	−3.325	−5.577	−2.281
Constant	2.292***	2.328***	5.54	2.256***
	−2.292	−2.278	−5.588	−12.226
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
R^2within	2.24	2.24	2.24	2.24
R^2between	1.00	1.00	1.00	1.00
R^2overall	1.00	1.00	1.00	1.00
Observations	35,072	35,072	34,229	34,22

Note: The impact of marketplace volatility (VOL) and worldwide catastrophes on OPU, business investment, and EPU is examined using generalized linear modeling (GML). The results are presented in Table 4 with detailed information on the variables included in the study. The *, **, *** indicating the significance levels of 10%, 5%, and 1% are presented in brackets based on the grouping at the fixed level.

and INVALT2, which capture the growth rate of total resources. These metrics have been widely used in previous studies as proxies for investment [43]. Table 6 presents the results of the robustness analysis. In columns 1 and 2 we conducted regression between oil price volatility and economic production utility using the INVALT1 metric, while in columns 3 and 4, we used the INVALT2 metric. The findings demonstrate that both OPU and EPU exhibit adverse and significantly correlations with the two proxy measures of business investment (columns 1–4). This suggests that the initial results hold even when considering other potential proxies for corporate investment.

Earlier in the paper, we examined the connection amid EPU and business investment. To validate our findings, we also considered the concept of global EPU introduced by Ref. [44].Similar to previous studies, we used global EPU as a substitute variable for national EPU. Column 5 of the table presents the results of Eq. (2) with global EPU replacing country-level EPU. The analysis using the worldwide EPU index yielded the consistent findings: a one percent increase in global EPU corresponded to a 0.006% decrease in corporate investment. Furthermore, we employed a proxy measure of OPU specifically oil price volatility estimated using the GARCH model, to capture uncertainty in oil prices [45]. The GARCH (1,1) model was applied to daily data for estimating oil price volatility. We observed that GARCHVOL significantly correlates negatively with firm investment. The finding indicated a significant negative correlation between GARCHVOL and firm investment. In summary, the various proxies for business assets, EPU, and fuel unpredictability consistently showed the similar trends at the aggregate level.

Our study corresponds to the results of previous studies [39]. find that the effect of EPU is more pronounced during periods of oil market uncertainty, only a few studies have included EPU in the oil-stock nexus interaction paradigm. One of the early studies exploring the relationship between EPU and the oil-stock nexus found that EPU amplifies the link in the oil-stock nexus [46]. [47] demonstrate improved predictability of stock market return using EPU and oil price data. This research deviates from the existing body of literature by investigating the long-term effect of EPU on oil-stock correlations from the perspective of regime switching. It aims to shed light on the diverse roles played by different sources and types of EPU in generating fuel-stock correlations of "EPU" in generating fuel-stock correlations.

4.3.4. *Further analysis*

This study investigates the influence of OPU (Organizational Political Uncertainty) and EPU (Economic Policy Uncertainty) on company investment, with the aim of assessing the potential involvement of firm-level determinants [48]. have shown that factors inside a corporation may alter the correlation between risk and investment. When a business makes decisions about its assets in uncertain situations, these decisions are impacted by shocks that are distinctive to the organization. Therefore, employing a sample that combines data from several firms may make the features of individual firms meaningless. In order to examine the potential disparity in the detrimental effects of OPU and EPU on business investment among businesses of varying sizes and cash flow volatility, we used the approach employed in previous studies and included company size and unpredictability as independent factors. To begin, we adopted the approach of [49] and divided our primary sample into two groups: small Size (firms whose Size is below the sample median) and big Size (firms whose Size is above the sample median). As suggested by Ref. [50], a company's external finance cost can be predicted by its Size. Small businesses face greater danger of economic constraints due to limited access to external financing and fewer assets to secure loans. The external cost of funding increases for small businesses due to knowledge asymmetry, leading to reduction in their assets. Consequently, the impact of both OPU and EPU on assets in small enterprises will be lower, if not negligible due to the higher price of outside financing and the significant level of cash reserves. Further tests on OPU and EPU based on the categorization of company size and cash flow unpredictability are presented in Table 7. Panel A Table 7, columns 1 and 2, show the

Table 6
Results for "robustness tests".

	1	2	3	4	5	6
OPU	−2.216*** (−2.25)		−1.106*** (−2.22)			
EPU		−1.139*** (−1.18)		−2.233*** (−2.26)		
Global EPU					−1.106*** (−1.13)	
Garch − Vol						−1.110** (−1.12)
Leverage	−4,0.426*** (−2.20)	−4.414** (−1.15)	−2.207** (−4.41)	−2.148*** (−2.26)	1.160*** (1.11)	1.128*** (1.14)
Size	−2.234*** (−12.25)	−3.336*** (−13.33)	−4.402 (−4.43)	3.356*** (21.16)	−1.111*** (−11.18)	−1.121*** (−41.16)
Growth	2.233*** (32.25)	3.331*** (33.37)	4.403*** (44.44)	3.309*** (43.38)	1.146*** (31.12)	1.160*** (41.12)
Tobin q	−1.124 (−1.10)	−3.306** (−3.33)	−6.674*** (−4.44)	−3.317* (−3.39)	−4.468*** (−4.33)	−01.191*** (−1.10)
CF	2.128*** (2.25)	4.432*** (3.35)	2.229*** (12.23)	3.307*** (13.33)	4.459*** (24.44)	1.142*** (−41.10)
GDP	−2.202 (−2.23)	−3.302 (−3.30)	−2.205* (−2.22)	−3.303 (−3.33)	4.401 (4.44)	1.103*** (1.17)
Constant	2.254*** (21.11)	5.590*** (23.37)	1.143*** (11.18)	−3.399** (−3.35)	4.496*** (14.44)	1.165*** (61.13)
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Firm FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R^2within	1.00	1.00	0.9	0.9	0.9	1.00
R^2between	1.00	1.00	0.9	1.00	1.00	1.00
R^2overall	0.99	1.00	1.00	1.00	1.00	1.00
Observations	33,875	33,113	35,067	34,245	32,552	35,028

Note: Additional reliability testing are summarized in Table 6. Details of the terms utilized in the study are defined in the appendix. The significance levels are indicated by t-statistics, with *, **, ***denoting the 10%, 5%, and 1% significance levels based on the remaining grouping at the company level.

results of OPU on business investment, broken down by the company size. As expected, we find highly negative values for big enterprises and only slightly negative results for small ones. Panel B of Table 7, columns 1 and 2, shows the effect of "EPU" on both small and big businesses. We observe statistically significant adverse outcomes for both big and small businesses in the sample. According to these findings, EPU poses a universal threat to businesses of any size.

In addition, we divided our sample into high and low-cash flow unpredictability groups to examine the impacts of OPU and EPU on the business assets [51]. suggest that businesses restrict assets when their cash flow is irregular, which align with the prior research indicating that firms adjust their asset strategy in response to cash flow volatility. Precautionary intentions to hold cash are associated with decreased company investment during periods of significant cash flow unpredictability [52]. Businesses with greater cash flow volatility tend to invest less as it is, therefore this may be a reflection of the adverse effects of oil price uncertainty and EPU on their assets. Therefore, in businesses with extremely variable cash flows, the potentially undesirable influence of OPU and EPU on assets may be reduced or nonexistent.

Based on the above, cash flow unpredictability can either help or hinder a company's investment choices. Our research objective is to determine whether the influence of oil price uncertainty and EPU on firm assets changes with the amount of volatility in cash flows. The standard deviation of the operational cash flow ratio to total resources over a five-year rolling window is used to estimate cash flow volatility. Our sample is split into highly volatile and less volatile enterprises based on their cash flow volatility. Companies are considered to have high (low) cash flow volatility if their cash flow variability is significantly greater (lower) than the model mean. The findings for OPU's effect on low and high cash flow volatility corporations' investments are presented in columns 3 and 4 of Panel A in Table 7. These findings are intriguing because they indicating negligible effects for both low- and high-volatility enterprises. The statistically insignificant results support our hypothesis that companies with higher cash flow unpredictability would reduce corporate investment, mitigating the impact of OPU on investment. Columns 3 and 4 of Panel B illustrate the outcomes of our tests on this association using the EPU proxy. The outcomes mirror those observe in the previous OPU scenario with companies experiencing low and high cash flow volatility investing less as EPU increases. Companies with high cash flow volatility are more severely affected compared to those with low volatility.

5. Conclusion

Recent research has extensively examined the significance of OPU and EPU in determining the corporate investment likelihood. This study represents first investigation into the experimental oil price uncertainty and EPU on business investment, utilizing data from

Table 7
Additional tests.

Panel A : Results with oil price uncertainty				
	1	**2**	**3**	**4**
OPU	−3.382	−3.350***	−2.242***	−4.462
	(−3.305)	(−3.319)	(−2.215)	(−2.239)
constant	−3.360***	3.360***	3.315***	1.172
	(−3.367)	−2.11	−3.389	3.301
All baseline controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
R^2within	3.34	3.27	3.34	3.35
R^2between	3.36	3.3	3.34	3.31
R^2overall	3.32	3.32	3.35	3.34
Observations	15,631	19,434	16,531	18,534
Panel B : Results with economics policy uncertainty				
	1	**2**	**3**	**4**
OPU	−2.219***	−2.266***	−3.375***	−2.296***
	(−2.228)	(−12.242)	(−13.361)	(−3.340)
constant	2.277*	2.215***	3.398***	3.305***
	−3.225	−13.334	−2.2259	2.11
All baseline controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
R^2within	0.25	0.12	0.24	0.26
R^2between	0.25	0.27	0.2	0.11
R^2overall	0.21	0.3	0.22	0.34
Observations	15,126	12,733	15,274	18,282

Note: Table 7 provides detailed results of supplementary test that account for business characteristics. Panel A focuses on corporate investment and the uncertainty of oil prices are analyzed using a GML regression. Panel B examines the impact of company size and cash flow unpredictability on the link among financial strategy indecision and business assets using GML regression. The findings for small and big enterprises are presented in columns 1 and 2, while the results of for cash flow volatility are shown in columns 3 and 4. The Appendix provides explanation for all the factors included in the analysis. The t-statistics denoting significance levels, are provided in brackets; such as*, **, *** representing a 10%, 5%, and 1% significance level, respectively. To enhance robustness at the firm level, we adjusted the standard errors.

the oil industry across 18 different countries. We developed three hypotheses to explain our gathered data. Firstly, we proposed that an increase in OPU would lead businesses to reduce their capital expenditures. Secondly, we anticipated that business investment would decline when EPU rises. Strong evidence was found supporting the notion that OPU and EPU had a statistically significant detrimental impact on business assets. We further explored this impact in various subsamples, including oil-producing vs. oil-consuming nations, higher versus lower market unpredictability, and during international economic crisis periods compared to non-crisis periods. In most cases, the findings remained consistent. Countries with substantial oil reserves were particularly vulnerable. Overall, the data suggest that oil price uncertainty and EPU negatively impact business investment in the oil industry, as well as other industries. This negative impact may be intensified when companies expand their operations into oil-rich. After accounting for variations in market company size and cash flow, our findings show that the association between OPU and EPU and business assets still holds. These results have significant bearing on the asset strategies that company managers and governments should adopt in light of the volatility of oil prices and EPU. Various avenues for further research exist; including sector specific studies to shed light on the effects of varying degrees of uncertainty on other business policies, such as capital structure and dividend policy.

Data availability

We collected energy related data from the US Energy Information Administration (EIA) website https://www.eia.gov/. Additional financial & GDP data was collected for each country from the World Bank website available at https://data.worldbank.org/.

CRediT authorship contribution statement

Yu Chen: Writing – review & editing, Writing – original draft, Methodology. **Shiyang Dong:** Writing – original draft, Software. **Siqi Qian:** Writing – original draft, Software, Project administration, Methodology, Formal analysis, Data curation. **Kai Chung:** Writing – review & editing, Writing – original draft, Software, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A

DEFINITIONS AND CATALOGUE OF VARIABLES

Table A1
Definitions of variables

Variable	Definition
“INV”	Investment expenses as a ratio of total resources as of the preceding year is one metric used to evaluate a business’s asset.
“INVALT1”	The ratio of a company’s capital expenditures to its assets, plant, and tools from the preceding year constitutes “INVALT1”.
"INVALT2"	The next possible adaptable for business assets is the annualized rate increase in total assets.
"OPU”	The “standard deviation” of daily returns on the cost of petroleum products indicates oil price uncertainty.
"GarchVol"	The “GARCH(1,1)” approach variability as a measure of crude oil’s unpredictability.
"EPU"	The monthly average of “economic policy uncertainty (EPU) index”
"GPU"	“Global policy uncertainty index (GPU)”.
"LEV"	Total liability divided by entire resources yields the leverage ratio.
“SIZE”	The natural log of a company’s total resources gives us an indication of the firm’s size.
"GROWTH"	The sales growth rate is simply the percentage change in sales from the prior year divided by sales in the prior year.
"Q"	The market price of resources divided by the book price of resources yields the “Tobin Q”.
"CF"	Determined by dividing “operating cash flow” by total resources
"GDP"	“A country’s GDP growth rate”
“Financial Crises”	A dummy variable with a value of 1 specifies the years of the “global financial crisis (2007–2009) and the Asian financial crisis (1997–1998)," while a value of 0 indicates any other year.
“Cash flow volatility”	Variation over a 5-year moving average of the ratio of operating cash flow to total resources
“Market volatility (Vol)”	When the one−year daily return variance of the global market is greater than the median sample value, the dummy variable is set to 1; otherwise, it is set to 0.

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