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Impact of Energy Policy Uncertainty on Firm-Level Capital Expenditure: A Study of Pakistani Firms

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Abstract

This study investigates the impact of the Energy-related Uncertainty Index (EU) on corporate investment in non-financial listed companies in Pakistan from 2010 to 2022. Utilizing a panel regression model with fixed effects, the analysis reveals a statistically significant inverse relationship between energy-related uncertainty and corporate investment. A 1% increase in the EU corresponds to a 0.052% decrease in corporate investment, highlighting the macroeconomic implications of energy uncertainty. The inclusion of control variables such as financial leverage, cash flows, and firm size further elucidates the factors influencing investment decisions. The findings highlight the need for stable energy policies to foster a conducive investment environment. Future research directions suggest broader geographic analysis, dynamic panel models, alternative measures of uncertainty, and sector-specific studies.

JEL Classification: C23, D80, G31, Q43

Keywords: Energy Uncertainty (EU), Corporate Investment, Developing Economy, Pakistan.

1 Introduction

Corporate investment choices have a significant impact on how much a company is worth on the market and, consequently, how wealthy its investors are. There is strong evidence that uncertainty has a detrimental impact on investment decisions, drawn from both theoretical

models and empirical studies (e.g., Bloom et al., 2007; Gulen and Ion, 2016). Energy uncertainty (EU), one of the many possible sources of this uncertainty, has received a lot of attention recently in the literature because of its significant influence on business investment decisions (e.g., Fuss et al., 2008; Yoon and Ratti, 2011; Dang et al., 2023; Xie et al., 2024). The purpose of this study is to investigate how the EU specifically affects corporate investment in the context of Pakistani companies.

The energy industry has seen significant volatility in recent years, largely due to a range of uncertainties including market dynamics, regulatory changes, and geopolitical issues that have had a significant impact on company investment strategy. In order to evaluate these uncertainties, (Dang et al., 2023) introduced the Energy-related Uncertainty Index (EU), which is a unique metric that takes into account changes in energy costs, policy dynamics, and technical improvements. This thorough index is essential for comprehending the intricate effects of energy-related concerns on business choices, particularly in the Pakistani industry.

Based on the real options theory presented by Dixit and Pindyck (1994), we understand that firms often face a dilemma between delaying investment to avoid potential risks and seizing immediate opportunities. We propose that a crucial factor impacting corporate investment decisions is the prevalent uncertainty related to economic policies (Fuss et al., 2008; Dang et al., 2023). Our study focuses on the influence of market competition on investment behavior. Prior research suggests that firms may be driven to invest heavily to maintain a competitive edge (e.g., Laksmana and Yang, 2015). However, other studies indicate that in highly competitive markets, firms may choose to postpone investments to mitigate the risks associated with uncertain regulatory environments (Abdoh and Maghyereh, 2020; Chen et al., 2020). This study aims to investigate these conflicting perspectives within the Pakistani context, where companies are particularly vulnerable to sudden changes in government policies.

Our analysis uses the EU Index, which was recently developed by Dang et al. (2023), to evaluate the impact of EU on company investment decisions. Utilizing an extensive panel dataset spanning 294 firms between 2010 and 2022 - which includes 5,017 firm-year observations - our

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paper examines the investing practices of Pakistani businesses. Corporate investment is determined as the percentage of total assets from the previous year that is allocated to long-term assets, such as fixed and intangible assets. This methodology aligns with research projects like Chen et al. (2020). The analysis shows a statistically significant adverse association between energy-related uncertainty and business investment using a panel regression model with fixed effects. Corporate investment falls by 0.052% for every 1% increase in the EU, demonstrating the macroeconomic effects of energy uncertainty. Additional explanation of the variables impacting investment decisions is provided by the addition of control variables such cash flows, business size, and financial leverage. The results emphasize that stable energy regulations are necessary to create a climate that is favorable to investment.

This research adds considerably to the body of knowledge on corporate investment and the uncertainty of policies, improving our comprehension of the interactions between these variables in the context of Pakistani businesses. This research closely examines the widespread impact of energy-related uncertainty on firm-level investment decisions, standing at the nexus of energy economics and corporate behavior. By carefully using the well-thought-out EU, our analysis both aligns with and extends the scope of earlier research in the field of energy economics, which has traditionally focused on the impacts of energy policy and market uncertainty. More specifically, our study advances the knowledge of energy economics by assessing the impact of uncertainty on corporate investment in Pakistan using the recently developed Energy-related Uncertainty Index (EU). Our research provides a more comprehensive framework for understanding the impact of energy-related uncertainty by applying the EU, which unifies several aspects of energy-related concerns. It expands on the work of Hou et al. (2021) by investigating how marketization levels interact with policy uncertainty in the energy sector and supports results from Adams et al. (2020) by emphasizing firm-level impacts rather than more general economic indicators. Additionally, the EU's comprehensiveness enables an in-depth study capable of capturing the intricacy of energy dynamics, rendering it a vital instrument for stakeholders to adeptly navigate the unpredictable energy landscape (Atsu and Adams, 2021).

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Our second major contribution is to identify the relationship, in the Pakistani context, between corporate investment and the Energy-related Uncertainty Index (EU). Our research focuses on energy-specific concerns, whereas previous studies, including those by Dixit and Pindyck (1994), have stressed the more general idea of investment under uncertainty. The results of Dang et al. (2023); Xie et al. (2024), which emphasize the significance of energy uncertainty in corporate decision-making, are consistent with this study. Our research provides empirical evidence to corroborate the theoretical assumptions of Real Option Theory by quantifying the negative impact of EU on investment, indicating that enterprises do, in fact, postpone investments given increased energy uncertainty. This highlights the timeliness of our results in a period defined by severe uncertainty in the energy markets and is consistent with previous study by Zhu and Yang (2021), who noted that market concerns during the pandemic pushed enterprises to reassess their investment strategies.

Overall, these contributions provide relevant insights into the increasingly unstable global energy situation, as well as improving our grasp of the intricacies inherent in business investment decision-making in the face of energy uncertainty. Policymakers and corporate strategists alike will find great value in these results as they manage the intricate dynamics of energy dependence and economic growth in the quickly changing Pakistani economy.

The subsequent sections of this paper are structured as follows: Section 2 offers a comprehensive review of essential literature. Section 3 presents an overview of the dataset used in this study, definitions of variables and econometric model. Section 4 discusses the empirical findings.

Finally, Section 5 concludes the study.

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2 Review of the Literature and Formulation of Hypotheses

2.1 Investment and Uncertainty

There have been conflicting conclusions in the literature on the relationship between business investment and uncertainty. According to groundbreaking theory of Knight (1921), entrepreneurs use uncertainty as a motivator to identify and take advantage of investment possibilities, which ultimately lead to the creation of profits through skillful resource combination. It is thus suggested that corporate profits flow through a state of uncertainty. In addition, according to economic theories presented by Hartman (1972); Abel (1983), which are based on perfect competition, constant returns to scale, and symmetrical adjustment costs, increased uncertainty might increase the expected profit margin of capital, which would encourage investment. The study by Abel and Blanchard (1986) provides empirical support for this theory.

On the other hand, Caballero (1991) contends that capital expenditures and growing uncertainty are inversely correlated, especially when specific economic assumptions are loosened. Real options theory provides more evidence in favor of this viewpoint. This theory contends that businesses must carefully consider the advantages of making present vs future investments due to the irreversible nature of many investment projects and the presence of sunk costs. Under circumstances of increased uncertainty, the benefit of postponing investments becomes more apparent, which results in a decrease in ongoing investment activity. Studies that look at how uncertainty affects investment decisions, including those by Bernanke (1983); McDonald and Siegel (1986), support this line of thinking.

2.2 Investment Decisions in Energy Sector

Over the years, numerous studies have been conducted on the impact of uncertainties on business investment decisions in the energy sector, demonstrating the ways in which various types of uncertainty-ranging from market dynamics to policy-influence these choices. For instance, the power generating industry was the focus of Blyth et al. (2007), where investments are significantly impacted by unknown future climate policy. They measured these regulatory

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risks and demonstrated that investments have a risk premium due to climate policy uncertainty, especially for technologies such as carbon capture and storage (CCS). The timing of investments and the technology selected for power generating can be considerably impacted by this uncertainty. Yang et al. (2008) examined how private investors' decisions in the power sector are impacted by government policy uncertainties on climate change using a real options technique.

Numerous studies have examined the effects of energy-price uncertainty, with an emphasis on the role of oil-price uncertainty as the primary stand-in for energy-related uncertainty in business investment decisions. For instance, Yoon and Ratti (2011) focused on US manufacturing enterprises while examining the impact of energy price uncertainty on firm-level investment. They came to the conclusion that increased energy price uncertainty makes investments less responsive to increases in sales, suggesting that businesses become more cautious when making investment decisions in such an environment. This effect was more noticeable in high-growth enterprises, indicating that the volatility of energy prices might have a substantial impact on the investment environment for businesses that are growing quickly. More recently, Yang et al. (2024) investigated how oil price uncertainty (OPU) affected inefficient corporate investment and found a negative correlation. This detrimental effect was true for the subsets with excessive and insufficient investments. Their observations are consistent with the tenets of both strategic growth option theory and real options theory. In addition, they identified one of the main contributing factors to the decreased inefficiency of the OPU investment as a shortened loan maturity structure. Additionally, the study showed that companies with reduced ownership concentration, those with substantial finance constraints, and state-owned organizations are more vulnerable to the negative consequences of OPU. Furthermore, it was observed that OPU resulting from increases in oil prices has a more noticeable detrimental effect on inefficient investment.

2.3 Research Objective, Theoretical Model and Hypothesis Development

While there is a significant research gap regarding the specific effects of the Energy-related Uncertainty Index (EU) on corporate investment strategies, particularly in the context of

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Pakistani firms, there is a substantial body of current literature regarding uncertainties in the energy sector and their effect on corporate investment decisions, as demonstrated by studies like Blyth et al. (2007); Yoon and Ratti (2011); Tylock et al. (2012) and others. While previous studies such as Phan et al. (2019); Maghyereh and Abdoh (2020); Hou et al. (2021) have provided insight into different facets of energy uncertainties, they have not yet explored the complexities presented by the comprehensive EU. This disparity is becoming more and more noteworthy in light of the changing dynamics of the energy market, which now cover more than just changes in the price of oil; rather, they also include things like energy costs, policies, and technological developments.

Objective—Analysis of the Impact of EU on Corporate Investment: The objective of this study is to analyze how Pakistani firms' investment decisions are affected by the Energy-related Uncertainty Index (EU), as proposed by Dang et al. (2023).

Building upon the reviewed literature, the theoretical model depicted in Figure 1 elucidates the interplay between energy-related uncertainties, corporate investment decisions, and firm characteristics framed within the Real Option Theory. This model contends that the general Energy-related Uncertainty (EU) significantly impacts Corporate Investment, serving as a critical variable in firm investment valuation and timing considerations. Below is an elaboration of the model and the formulated hypothesis addressing the research question.

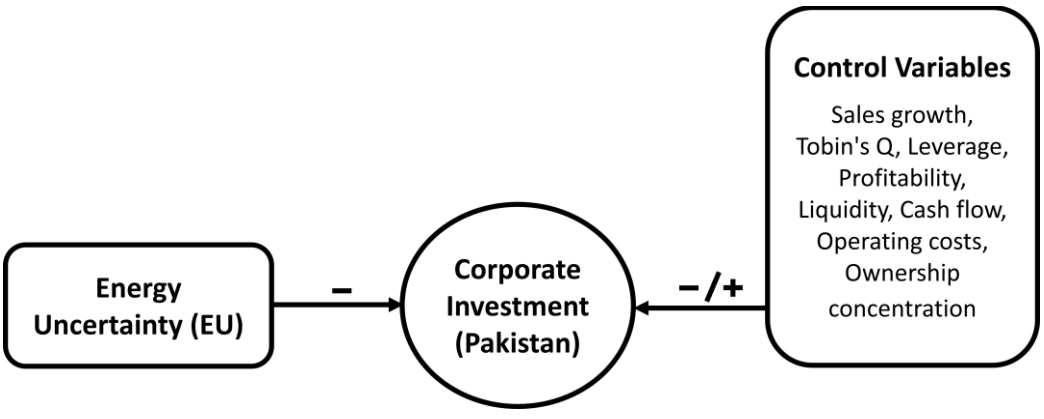

Figure 1: The theoretical model of the study based on existing literature.

Research Question—What is the Impact of EU on Corporate Investment?

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Informed by existing research (e.g., Xie, 2009; Tong and Li, 2011; Chen et al., 2020; Xie et al., 2024), there appears to be an inverse correlation between EU and Corporate Investment. This suggests that with increasing EU levels, firms tend to exhibit diminished investment tendencies. This relationship is often attributed to the 'option value of waiting', where firms, under uncertainty, decides to defer investments to preserve flexibility and acquire additional information. Thus, the hypothesis posited is:

> **Hypothesis:**—An increase in the Energy-related Uncertainty Index (EU) results in a decrease in corporate investment.

3 Sample and Methodology

3.1 Data

In this analysis, we use an annual unbalanced panel dataset sourced from the State Bank of Pakistan's publication "Balance Sheet Analysis of Non-financial Firms (BSANFFs) of Pakistan." Our sample includes 294 non-financial companies listed on the Pakistan Stock Exchange (PSE) from 2010 to 2022. To ensure data accuracy, we applied several exclusion criteria. We excluded companies in the financial sector, observations with incomplete data or missing total assets, enterprises listed for less than a year, and organizations involved in special treatments or transactions. We opted for an unbalanced panel dataset to account for changes in business status over time. Additionally, to reduce the impact of statistical outliers, we adjusted continuous variables at the 1% and 99% levels. Our final dataset comprises 5,017 firm-year observations from 294 different firms.

3.2 Main Variables

3.2.1 Energy-Related Uncertainty (EU)

The main variable under investigation, Pakistan's energy-related uncertainty index (EU) (data sourced from https://www.policyuncertainty.com/), is taken from Dang et al. (2023). The EU is a newly created method for quantifying energy market uncertainty.

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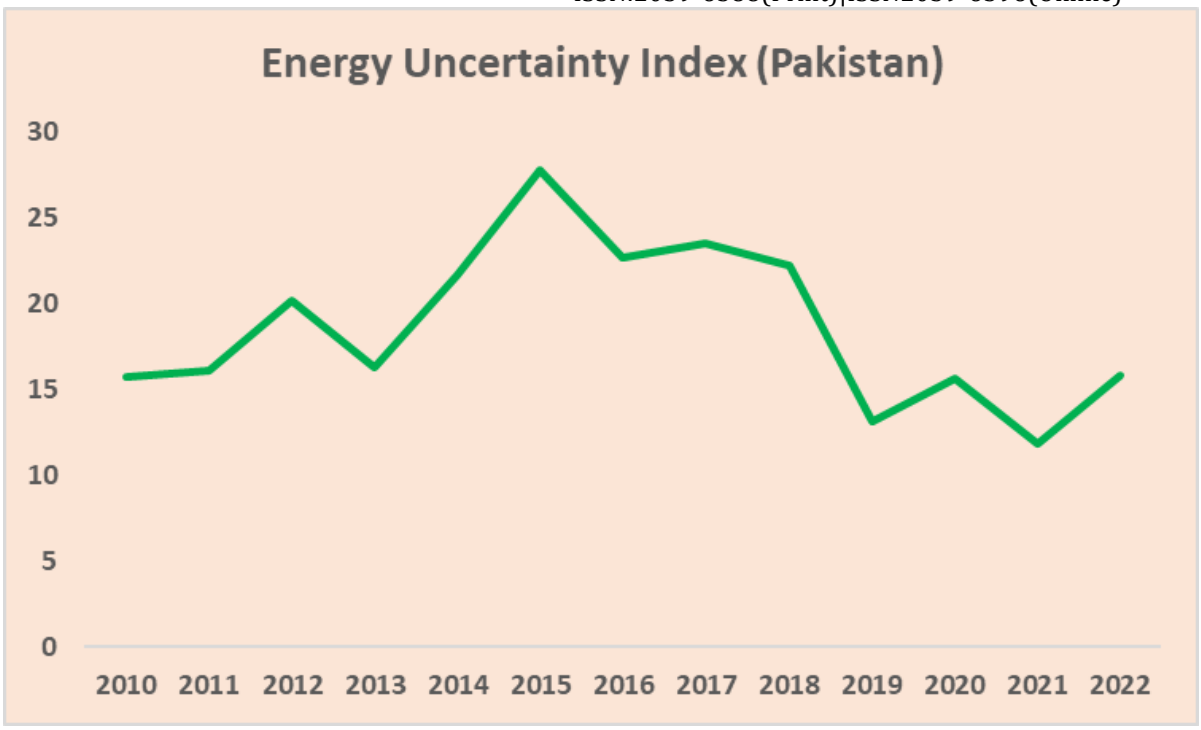

Figure 2: The Energy-related Uncertainty Index (EU) of Pakistan from 2010 to 2022.

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Text analysis techniques are used to create the EU using monthly country reports that are released by the Economist Intelligence Unit (EIU). The articles are thorough and include a wealth of qualitative data on a variety of economic, political, and industry-specific topics for both established and developing nations. From this qualitative material, the EU extracts quantitative uncertainty measures by determining the frequency and context of occurrences of keywords related to energy.

In accordance with the approach expanded from Afkhami et al. (2017), the index includes a predetermined list of energy-related terms. These keywords include, among other things, “oil price volatility,” “renewable energy regulation,” and “energy supply disruption.” Additional keywords capturing energy shocks and crises, such as “energy embargo,” “nuclear energy crisis,” and “electricity shortage,” have been included to improve the index’s precision and relevance to current situations. Finding these keywords in the EIU reports and evaluating the context in which they occur are the first steps in determining the degree of uncertainty they represent. This strategy makes sure that the index captures both expected oscillations and unanticipated shocks,

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reflecting sentiments and movements in the energy market in real time. With a typical base index value of 100, the index is calculated in relation to a base year, making it simple to compare changes over time. Readers are referred to Dang et al. (2023) for a thorough knowledge of the individual components and their weights in the EU calculation.

Since we record our EU data monthly, we take the average of the monthly EU values throughout the course of each year to convert it into an annual measure. It should be noted that in addition, we employ time-weighted EU in accordance with Gulen and Ion (2016); Jing et al. (2023), which gives greater weight to recent months in order to capture the most pertinent and recent trends in energy uncertainty.

3.2.2 Corporate Investment

In accordance with prior research (e.g., Chen et al., 2020), we define company's investment as the funds used for developing and buying tangible and intangible assets as well as other long-term assets, as reported in the cash flow statement. To more effectively compare various companies, this investment is divided by the total assets of the company. This measure becomes our dependent variable; henceforth it will be referred to as CINV.

3.2.3 Control Variables

We incorporate the following firm-level variables as controls, drawing from earlier research (e.g., Jiang et al., 2018; Chen et al., 2020): annual growth in sales, Tobin's Q, debt-capacity, return on total assets, financial leverage, cash reserves, cash-flow, ownership concentration, company size, and administrative costs. Table 1 provides the details. The literature now in publication carefully considers whether control factors have a demonstrated impact on business investment decisions before choosing them. These factors are essential for pinpointing the precise effect of energy-related uncertainty while also comprehending the larger dynamics of investment behavior.

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Table 1: Variable Definitions.

Variable	**Symbol**	**Definition**
Dependent Variable		
Corporate Investment	CINV	Expenditure on fixed assets, intangible assets, and other long-term assets, adjusted relative to total assets at the year end.
Independent [Main]		
Energy-related Uncertainty Index	EU	Derived from a text analysis of monthly country reports from the Economist Intelligence Unit (EIU).
Independent [Control]		
Financial Leverage	LEVG	Ratio of total debt to total assets.
Cash flows	CFlow	Net cash flow from operating activities divided by total assets.
Return on total assets	ROA	Net profit divided by average total assets.
Administration costs	Adexp	Administrative expenses divided by gross revenue.
Largest equity-ownership holder	T1	Ownership proportion of the largest shareholder.
Equity-ownership concentration	HI5	Herfindahl index of the top five shareholders.
Tobin's Q	TQ	Market value of the firm divided by total assets.
Growth in Sales	SGR	Year-over-year growth in sales.
Liquidity	LIQ	Sum of cash and tradable financial assets divided by total assets.
Borrowing capacity	BC	Proportion of fixed assets relative to total assets.
Firm Size	FSIZE	Natural logarithm of the total assets of the firm.

The variables of annual growth in sales, return on total assets (ROA), and cash flow are included since they are important indicators of a company's ability to make investments because they show how financially sound and efficiently it operates. When comparing market valuation to asset costs, Tobin's Q is used to evaluate the difference, giving investors insight into whether a company is overvalued or undervalued by the market - an important consideration when making investment decisions. A company's financial structure is reflected in its debt capacity and financial leverage, which has an impact on its ability to finance new initiatives, particularly in times of fluctuating economic conditions. When assessing a company's liquidity buffer-which affects investment during uncertain times - cash reserves are taken into account. Incorporating Ownership Concentration takes into consideration how the structure of shareholders affects business strategy and policy, especially when it comes to investment choices. Because larger firms may have distinct investment habits due to their resources and market impacts, company

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size is employed to adjust for the scale effect. Finally, administrative costs are included since they show how efficiently operations run, which can either free up or restrict the amount of resources that can be invested.

3.3 Econometric Model

In accordance with the body of research on the connection between uncertainty and corporate investment (e.g., Chen et al., 2020; Xie et al., 2024), we utilize the two-way fixed effect model in our regression analysis:

$$CINV_{i,t} = \alpha_0 + \alpha_1 EU_{t-1} + \alpha CV_{i,t-1} + \eta_t + \varphi_i + \epsilon_{i,t} \quad (1)$$

$CINV_{i,t}$ denotes the corporate investment made by firm i in the year t in Equation (1). The uncertainty index related to energy is denoted by EU_{t-1}. As shown in Table 1, a vector of control variables is represented by $CV_{i,t-1}$. The year-fixed effect, η_t, helps to reduce the impact of macroeconomic factors, while the firm-fixed effect, u_i, is indicated. Lastly, the unobservable exogenous error component is represented by $\epsilon_{i,t}$. Existing research (Jiang et al., 2018; Chen et al., 2020) indicates that while firm-specific control variables are lagged by one period, investment is monitored contemporaneously. This decision is driven by two factors: first, firms frequently use data from the firm-level variables of the prior year to guide their investment decisions; second, using firm-level control variables from year $t-1$ may reduce endogeneity-related concerns (Jiang et al., 2018). See Table 1 for additional information on control variables.

To take heteroscedasticity into account, we use robust standard-errors, which guarantees the validity of our estimates even in cases where the error variance between the data is not constant. We also consider the likelihood of within-company correlation in our panel dataset, thus we cluster our standard errors at the firm level. This adjustment is important because it accounts for the potential that over time, corporate practices and results within the same organization may not be entirely independent. Our goal in doing this is to improve the robustness of our findings and provide more reliable and accurate inference in our statistical analysis.

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4 Results and Discussion

4.1 The Impact of EU on Corporate Investment

We employ a panel regression model for our empirical research in this work. We apply the Hausman (1978) test to verify that the panel regression model with fixed effects is appropriate for our empirical study. Although they are not displayed here, the comprehensive test results are available upon request. Three specifications for the regression findings are shown in Table 2. No control variables are used in the estimation of Model 1. Without taking into account any potential confounding factors, it offers insight into the link between the dependent variable (business investment) and the primary explanatory variable (EU energy-related uncertainty index) in isolation. The EU is not present in Model 2, but control variables are. The goal of include control variables is to take into consideration other elements like financial leverage, cash flows, firm size, etc. that may have an impact on corporate investment. To evaluate the effect of control variables without the influence of energy-related uncertainty, EU is purposefully left out. But Model 3 takes into account both the control variables and the EU. It offers a thorough study by taking into account the combined effects of control and EU factors on corporate investment. This makes it possible to comprehend how business investment decisions are influenced by energy-related uncertainties in addition to other considerations.

The negative coefficients for EU −0.061 and −0.052, respectively, which are significant at the 1% level, are a noteworthy observation from Models (1) and (3). These coefficients show a statistically significant inverse relationship between energy-related uncertainty and corporate investment, with a 0.052% decrease in corporate investment corresponding to a 1% increase in energy-related uncertainty, holding other factors constant. A more thorough knowledge of the factors impacting corporate investment is provided by the inclusion of control variables and EU, as evidenced by the Adjusted R^2 values (0.088 for Model 1, 0.174 for Model 2, and 0.197 for Model 3). Compared to the other models, model (3) explains a larger percentage of the variance in corporate investment.

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Table 2: Regression Results: The Impact of Energy Uncertainty on Corporate Investment

Variable	(1)	(2)	(3)
EU	−0.061***		−0.052***
	[0.000]		[0.000]
ROA		0.066***	0.064***
		[0.000]	[0.000]
Adex		0.018**	0.023**
		[0.064]	[0.061]
SGR		0.002	0.002
		[0.651]	[0.667]
LEVG		−0.041***	−0.043***
		[0.000]	[0.000]
T1		0.079***	0.077***
		[0.000]	[0.000]
HI5		−0.076***	−0.077***
		[0.000]	[0.000]
TQ		0.006***	0.006***
		[0.000]	[0.000]
Cflow		0.039***	0.039***
		[0.000]	[0.000]
LIQ		0.008**	0.008**
		[0.042]	[0.041]
BC		−0.109***	−0.108***
		[0.000]	[0.000]
FSize		0.004	0.004
		[0.432]	[0.401]
Constant	−0.044***	−0.061***	−0.062***
	[0.000]	[0.000]	[0.000]
Firm FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
No. of obs.	5,124	5,124	5,124
Adjusted R^2	0.088	0.174	0.197

Note: The table shows the estimated results of the impact of the energy-related uncertainty index of Pakistan Dang et al. (2023) on corporate investment in Pakistan. Each row represents a different variable, and each column represents a different regression model. Model (1) presents the relationship between corporate investment and EU without any control variables, highlighting the direct effect of EU in isolation. Model (2) includes control variables but excludes the EU, allowing for an examination of the effects of the control variables alone. Model (3) incorporates both EU and the control variables, providing a comprehensive view of their combined influence on corporate investment. 'Yes' under 'Firm FE' and 'Time FE' indicates the inclusion of firm and time-fixed effects in the regression models, respectively. 'No. of obs.' refers to the number of observations used in each regression, providing insight into the sample size. Additionally, 'Adjusted R^2' represents the adjusted coefficient of determination for each model, indicating the proportion of variance in the dependent variable explained by the independent variables, adjusted for the model's degrees of freedom. Moreover, significance levels are represented by *** for the 1% level, and ** for the 5% level, corresponding to the coefficients.

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As we continue to investigate the dynamic interactions between the Energy-related Uncertainty Index (EU) and Corporate Investment (CINV), our empirical model (3) offers fascinating new perspectives on the ways in which certain firm-level control variables are involved in these interactions. When we go into the details of the model's output, the coefficients of each variable provide an explanation that either supports or contradicts conventional economic theories. For instance, a positive coefficient for Return on Assets (ROA) indicates that higher profitability is linked to larger business investment. This is explained by the fact that there are more internal funds available due to larger profitability, which may be used for investment without requiring outside funding. This claim aligns with the body of known financial research, which holds that investment decisions are primarily driven by profitability (Myers and Majluf, 1984). In contrast, in the presence of other factors, the Sales growth (SGR) did not demonstrate a statistically significant impact on investment. This may suggest that investment decisions are not exclusively influenced by recent sales performance or that other variables in the model account for the impact of sales growth, rather than diminishing the significance of sales growth as a measure of a company's performance. This may be consistent with viewpoints that consider more immediate financial indicators to have a greater direct impact on investment than sales growth (Chen et al., 2020; Xie et al., 2024).

The significant positive coefficient for administration costs indicates that, contrary to popular belief, higher administrative costs as a percentage of revenue are correlated with larger corporate investment. This may, however, be understood in the context of businesses investing in administrative skills, which could spur future expansion and gains in productivity. Advanced information technologies and human resources may be included in these investments, which can enhance operational efficiency and strategic decision-making. This is in line with the resource-based approach, which holds that businesses invest in capabilities and resources to gain a competitive edge and increase efficiency (Barney, 1991). The coefficient on leverage (LEVG) is negative, making it stand out. The trade-off hypothesis of capital structure is in line with the negative correlation between leverage (LEVG) and investment, which serves to strengthen the risk-averse characteristics of companies with high debt levels. Because of increased financing costs and possible financial difficulties, companies with larger debt levels may find it more

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difficult to make new investments (Modigliani and Miller, 1958). Additionally, the model's borrowing capacity (BC) has a negative coefficient. From an economic perspective, this would indicate that a sizable amount of their fixed asset holdings may have a smaller debt capacity since lenders might be hesitant to give out more credit because of the perceived increased risk.

The variable for the largest stock ownership holder, T1, shows a positive coefficient after more research into market dynamics. This implies that greater investment is linked to a larger ownership share held by the largest shareholder. According to the principal-agent theory, which contends that concentrated ownership lessens agency conflicts and may promote investment in line with the principal's interests, this could indicate that concentrated ownership can lead to more definite and effective decision-making regarding investment opportunities (Jensen and Meckling, 1976). Furthermore, theories of ownership structure and company performance support the idea that larger shareholders are generally more driven to increase firm value and may have more influence over the business's strategic choices (Shleifer and Vishny, 1986). Given that Tobin's Q has a positive coefficient, businesses are more likely to invest if their market valuation is higher than the cost of replacing their assets. Economic theory provides strong support for this relationship, with a higher Tobin's Q value often understood as an indication of investment-ready growth potential (Tobin, 1969). Furthermore, the pecking order theory, which contends that businesses prefer to finance investments internally when feasible, is compatible with a positive coefficient for cash flow. The ability to finance investments without turning to outside borrowing, which may come with extra costs or signaling problems, is made possible by ample cash flow (Myers and Majluf, 1984).

Finally, both Firm Size (FSize) and Liquidity (LIQ) report positive coefficients. Since liquid assets give businesses the flexibility to make timely investments, lessen their reliance on outside funding, and lessen the consequences of market frictions, the beneficial impact of liquidity on investment is anticipated (Opler et al., 1999). Lastly, larger firms tend to invest more, as indicated by the positive coefficient on firm size (FSize) (Rajan and Zingales, 1995). This can be explained by their greater access to capital markets and the advantages of economies of scale, which can lower investment costs and make large investments more affordable.

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Overall, these findings show how energy-related uncertainty (EU) affects corporate investment in Pakistan. The results indicate a discernible decline in business investment as EU rises.

There appears to be a strong correlation between these variables because this inverse association holds true for many model settings. The results of earlier research in the topic are in line with this pattern. For instance, Yoon and Ratti (2011) discovered that increased energy price uncertainty caused businesses to become more conservative, which decreased their investment responsiveness to sales growth. The study focused on manufacturing enterprises in the United States. Furthermore, Gulen and Ion (2016) demonstrated a robust negative correlation between policy uncertainty and corporate investment, implying that policy uncertainties in the government, particularly with regard to energy policies, can inhibit corporate investment by causing delays because of the irreversibility of investments.

To summarize, the findings of the regression analysis, when combined with the body of current research, provide compelling evidence that uncertainty connected to energy plays a major role in business investment choices. This realization emphasizes the significance of stability in the energy sector for creating a climate that is favorable for corporate investment, making it especially pertinent for directing policy and business strategy.

5 Conclusion, Limitations, and Future Directions

5.1 Conclusion

The important implications of variations in Pakistan's Energy-related Uncertainty Index (EU) on corporate investment inside Pakistani non-financial listed companies have been methodically investigated in this study. Our research has a solid foundation because to our large dataset, which includes 5,017 firm-year observations and covers 294 firms between 2010 and 2022. The findings show that, on average, a 1% increase in the EU causes a 0.052% decrease in business investment. This quantification demonstrates the macroeconomic ramifications of such processes, especially in a developing country such as Pakistan's, and validates the concrete influence of energy-related uncertainty on investment decisions.

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Supporting data collected through alternative EU measurement methodologies adds credence to the study and strengthens the robustness of these conclusions. Policymakers and business strategists can gain a deep understanding of the relationship between energy-related uncertainty and corporate investment activities, especially in Pakistan, with the crucial insights obtained. In addition to adding to the body of knowledge in corporate investment and energy economics, this research helps policymakers and business executives navigate the difficulties brought on by energy-related uncertainty. The results show that in order to make wise investment decisions in a global energy market that is becoming more and more unpredictable, businesses, particularly those involved in energy-intensive industries, require tailored strategies that take into account their particular characteristics.

Overall, by providing actual data on the variables impacting business investment, our research advances the body of knowledge.

5.2 Limitations and Future Directions

Our study employs a panel regression model with fixed effects to investigate the impact of the Energy-related Uncertainty Index (EU) on corporate investment. While our findings offer valuable insights, several limitations should be acknowledged, and directions for future research are proposed.

5.2.1 Limitations

1. **Scope of Data**: Our dataset covers non-financial listed companies in Pakistan from 2010 to 2022. This geographic and sectoral focus limits the generalizability of our findings to other countries or sectors, particularly those with different economic conditions or energy dependencies.

2. **Variable Omission**: Although we included several control variables, other potential factors influencing corporate investment, such as macroeconomic indicators (e.g., GDP growth, inflation), political instability, or sector-specific dynamics, were not considered. Their exclusion might lead to omitted variable bias.

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3. **Fixed Effects Model**: While the fixed effects model controls for unobserved heterogeneity, it does not account for potential dynamic relationships between variables over time. Dynamic panel models, such as the Generalized Method of Moments (GMM), could provide deeper insights into these temporal dynamics.

4. **Measurement of EU**: The Energy-related Uncertainty Index, though comprehensive, may not capture all dimensions of energy uncertainty. Future studies could benefit from incorporating alternative or additional measures of energy uncertainty, such as volatility in energy prices or supply disruptions.

5. **Endogeneity Concerns**: There might be endogeneity issues arising from reverse causality or omitted variable bias. Although our methodology mitigates some of these concerns, instrumental variable approaches could further address potential endogeneity.

5.2.2 Future Directions

1. **Broader Geographic and Sectoral Analysis**: Extending the analysis to include other countries or sectors could enhance the generalizability of the findings. Comparative studies between developed and developing countries could provide a more nuanced understanding of the impact of energy uncertainty.

2. **Dynamic Panel Models**: Employing dynamic panel data models, such as the GMM, could help explore the potential lagged effects and dynamic interactions between energy uncertainty and corporate investment.

3. **Alternative Measures of Uncertainty**: Future research should explore different measures of energy-related uncertainty, including those related to policy uncertainty, geopolitical risks, and technological changes in the energy sector.

4. **Qualitative Approaches**: Complementing quantitative analysis with qualitative research, such as case studies or interviews with corporate executives, could provide deeper insights into how firms perceive and respond to energy-related uncertainty.

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5. **Policy Implications**: Investigating the effectiveness of various policy measures aimed at mitigating the impact of energy uncertainty on corporate investment would be valuable. This could involve analyzing the role of government interventions, subsidies, and regulatory frameworks.

6. **Technological Advancements**: Examining the role of technological advancements and innovations in energy efficiency and renewable energy sources could offer insights into how firms can mitigate the adverse effects of energy uncertainty.

7. **Sector-Specific Studies**: Conducting sector-specific analyses, particularly in energyintensive industries, could uncover unique challenges and strategies that firms employ to navigate energy-related uncertainties.

In summary, while our study provides robust evidence on the impact of energy-related uncertainty on corporate investment in Pakistan, recognizing its limitations and exploring future research avenues will enhance our understanding of this complex relationship. Addressing these limitations and expanding the scope of research will contribute significantly to the fields of corporate investment and energy economics, offering valuable insights for policymakers and business
strategists.

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