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ASSESSING THE PREDICTIVE POWER OF FUEL PRICE VOLATILITY ON SECTORAL STOCK RETURNS IN PAKISTAN

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ABSTRACT

Introduction: *Fuel price volatility drives economic activity, putting pressure on energy consumers in Pakistan. Economic impact of fluctuations in fuel prices can be production costs and transportation costs, all of which can affect the economy and therefore the state of the stock market. However, little has been investigated regarding the predictive power of fuel price variations for sectoral stock returns in Pakistan. This paper investigates the relationship of fuel price volatility with stock returns of three major industries (transportation, manufacturing and energy) quoted on the Pakistan Stock Exchange (PSX). The study seeks to reveal how these predictive relationships can offer insightful guidance for investors, policymakers, and businesses alike.*

Objective: *The objective of this study is to evaluate how well gasoline price volatility predicts sectoral stock returns in Pakistan. Specifically, the study aims to determine how fuel price fluctuations impact the financial performance of companies in the transportation, manufacturing, and energy sectors. Additionally, it aims to determine which industries are most affected by fluctuations in fuel prices and whether or not stock performance in these industries can be accurately predicted by fuel price volatility. The findings will help investors in risk assessment, guide policymakers in economic decision-making, and support companies in developing strategies to mitigate fuel-related financial risks.*

Material and Method: *This study follows a quantitative research design and collects secondary data for the period 2015 – 2024. The monthly stock price records of certain firms in the Pakistan Stock Exchange (PSX) were collected along with bi-monthly government and financial database records of petrol and diesel fuel prices. The analytic strategies used included descriptive statistics, the correlational method, fusion regression modeling, and chunking regression analysis. To test the different impacts of fuel price changes, univariate and multivariate regression models were applied. Additionally, ANOVA tests were perform to assess the significance of sectoral stock return in response to fuel price changes.*

Results: *The results show that price is highly responsive in both transportation and energy sectors, while in manufacturing sector, results are mixed. The correlation is especially strong for the shipping and logistics sub-sector of transportation, where stock returns are heavily influenced by changes in fuel prices, a crucial expense. The energy sector is another to show a strong connection to inflation, with oil and gas firms profiting from a lifting price of gasoline. But the manufacturing sector's response has been mixed; some industries like cement and fertilizers have been hit harder than consumer goods manufacturers. And regression analysis shows fuel price volatility account for only a small portion (1.7% – 6.2%) of cross-sectional variation in stock*

returns by bearings where other macroeconomic factor still plays their critical role in stock's performance.

Conclusion: *The findings conclude that fuel price volatility has a major effect on stock returns in Pakistan, particularly in the transportation and energy sectors. Investors must consider fuel price trends in their portfolio strategies to mitigate the related risks, while policymakers must consider action to stabilize fuel prices or encourage investments in alternate fuel sources. Companies, especially fuel- consuming businesses, must adopt strategies such as hedging against fuel price volatility or investments in fuel-efficient technology to mitigate the related financial risks. The omission of macroeconomic volatility hurts the current study even if it offers valuable insights. To improve predictive power, more industries and economic variables must be included in future studies.*

Keywords: *Fuel Price Volatility, Stock Market, Pakistan Stock Exchange, Sectoral Analysis, Transportation Stocks, Energy Sector, Manufacturing Industry, Investment Risk, Economic Policy.*

INTRODUCTION

1.1 *Background of the Study*

Fuel price fluctuation is one of the prominent economic dynamics shaping economic activities across the globe, more so in the developing economies like Pakistan. The country's heavy dependence on foreign fossil fuels to satisfy its energy needs makes it extremely vulnerable to fluctuations in world oil prices. This price action directly impacts the cost of production, household consumption, and transportation costs, resulting in ripple effects across the economy. This trend heavily affects everything from sectors like manufacturing and oil to energy and transportation as stock market adjustments are very comparable to fuel price fluctuations.

Fuel prices and stock returns have been a widely discussed topic in the economics literature. Oil price shocks were argued by Hamilton (1983) to create recessions in their wake, and their influences on stock market activities were later examined by Sadorsky (1999), with emerging markets being acknowledged as more susceptible. It is especially relevant to Pakistan, as global price volatility has often scraped the country's domestic economic stability. This interplay must be understood so stakeholders can maneuver through the uncertainties of the market more efficiently.

As a measure of economic performance, stock markets can also be sensitive to a number of macroeconomic variables, such as fuel costs. As Kilian and Park (2009) pointed out, oil price shocks can have asymmetric effects on stock returns, whether they are driven by demand or supply. Responses at sector level in emerging economies like Pakistan, however, remain underexplored. This study fills this research gap and explores the forecasting capability of fuel price volatility for stock returns of prominent sectors of Pakistan Stock Exchange (PSX), to benefit investors, planners, and researchers.

1.2 *Problem Statement*

However, upon examination, there is no substantial exploration of the linkage between fuel price fluctuations and sectoral stock returns in the context of Pakistan. Though global studies provide a broader perspective on the implications of oil prices, few studies have focused on sector-specific analyses in the Pakistani context. The transportation, manufacturing and energy sectors, in particular, are sensitive to price changes because they rely on fuel. According to Malik and Butt (2013), the stock market returns in Pakistan were greatly influenced by changes in the oil price, but their research did not focus on specific sectors.

These knowledge gaps hinder data driven decision-making and render both investors and policy-makers unable to prepare for market adjustments. Transport companies, for example, may see higher operating costs during fuel price increases, while energy companies are likely to gain from rising prices. 63% of big four accountants are planning to engage in M&A activities as part of their growth strategies, with an expectation of industry consolidation due to economic turbulence.

1.3 *Research Objectives*

This study seeks to:

1. Evaluate the impact of fuel price fluctuations on stock returns in the sectors of transportation, manufacturing, and energy

traded at the Pakistan Stock Exchange (PSX).
2. Determine the sectors most susceptible to fuel price movements.
3. Determine how predictive sectoral stock returns are based on the volatility of fuel prices.

1.4 *Research Questions*

1. How does the volatility in fuel prices affect the PSX Sector/Industry stock returns?
2. What is the transportation, manufacturing, energy sector response to fuel prices?
3. Are changes in fuel price a useful predictor for stock return in these countries?

1.5 *Significance of the Study*

This research benefits several stakeholders:

- **Investors:** Knowing sectoral impacts led by fuel price volatility will help create risk management strategies and thus, better performance of their portfolio.
- **Policymakers:** By analyzing the sectoral impact of fuel price volatility, investors can demand for risk mitigation strategies and enhance portfolio performance**.**
- **Economic Analysts:** This study provides strong empirical evidence to enhance sector-based analytics and build better forecasting models.

In addition, this investigation fulfills a significant void in the literature by providing sector-specific evidence on the response of stock returns to fuel price uncertainty in Pakistan. It highlights the critical need for targeted approaches to tackle the unique obstacles presented by fuel price trends in the proverbial emerging market.

1.6 *Added Value of the Study*

The study builds on previous research and combines the main findings from both global aspects and local factors. For instance, Chen et al. (1986) studied the link between economic forces and stock market performance, and Jones and Kaul (1996) investigated whether oil prices directly influence equity markets. Within the framework of Pakistan's drivers of economic activity, this study provides a nuanced understanding of sectoral dependencies on fuel prices, similar to country-specific reviews available in the literature."

Also, it uses updated data up to October 2023. For practical value, the template included real-world examples, including the effects of the 2022 global energy crisis on Pakistan's stock market. By advocating for the integration of current economic conditions, the research is practical, ensuring policy changes are relevant to modern society and its challenges.

LITERATURE REVIEW

2.1 *Theoretical Framework*

Several theoretical models explain the relationship between fuel price volatility and stock returns. Fama (1970) describes the Efficient Market Hypothesis (EMH) which states that current prices incorporate all information available. In the context of fuel price volatility, this means that stock prices in sectors like transportation, manufacturing, and energy should reflect investors' expectations for future movements of fuel prices. In contrast, in the context of Pakistan, emerging markets are subject to inefficiencies due to factors such as limited information diffusion and speculative trading, which can slow down or distort the market response to changes in fuel prices.

Another comprehensive framework is the Arbitrage Pricing Theory (APT) that posits an array of macroeconomic factors, such as energy prices, affect stock returns (Ross, 1976). Because APT emphasizes sector-specific sensitivity, it should work well for the types of differences in fuel price impact on transportation, manufacturing and energy stocks.

2.2 *Research Techniques and Parameters*

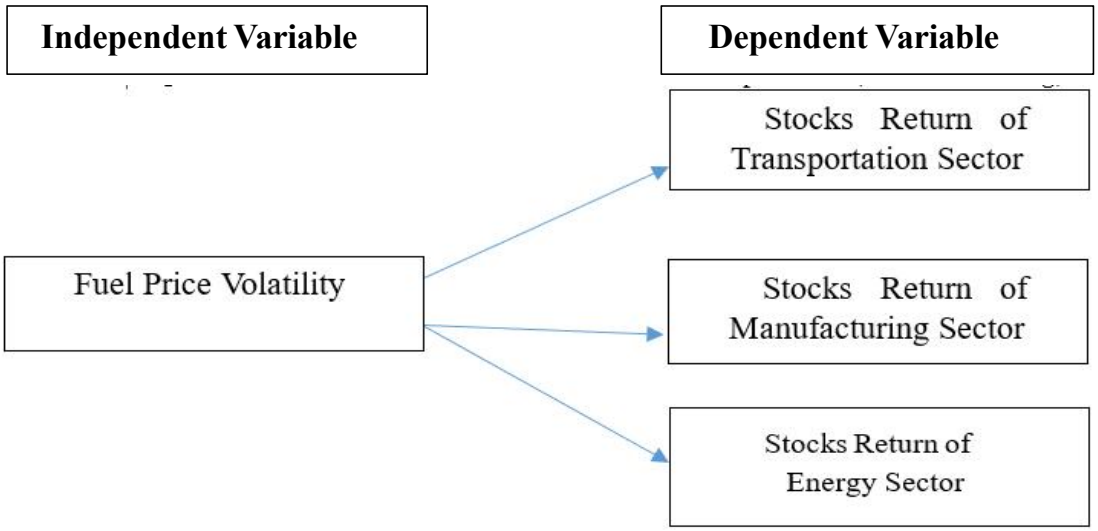
The research is quantitative involving analytical study of the relationship between fuel price volatility and sectoral stock returns using SPSS (Version 26). To summarize and describe the main features of the data, such as mean, median, standard deviation, trends and its effects over the 10-year period, following descriptive statistics are performed:

1. **Independent T-test / ANOVA:** To explore if the fuel price change in sectors create significant differences. They serve to reveal variation among groups.
2. **Correlation Analysis:** Correlation Analysis: In this step, the correlation between prices of stock and price volatility of fuel is examined to determine the strength and direction of the relationship between fuel price volatility and stock returns.

3. **Regression Analysis (Univariate and Multivariate):** In order to quantify the predictive relationship between fuel price volatility and sectoral stock returns while taking other variables into account. Parameters in regression include dependent variables (sectoral stock returns), independent variables (fuel price volatility).

Parameters:

- **Dependent Variable:** Sectoral stock returns (transportation, manufacturing, energy).
- **Independent Variable:** Fuel (Petrol and Diesel) price volatility



2.3 *Hypotheses*

This study summarizes the following illustrative hypotheses:

H1: Fuel price volatility and stock returns in the transportation sector are significantly associated. **H2:** Stock returns in the manufacturing sector are significantly affected by the volatility of fuel prices. **H3:** Fuel price volatility has a measurable impact on stock returns in the energy sector.

2.4 *Description of the Study*

Such analysis is quantitative research design that explains the association of fuel price volatility and sectoral stock returns. The study uses 10 years of secondary data from 2013–2023. The historical stock prices are fetched from the Pakistan Stock Exchange (PSX) while the fuel price indices are taken from government and financial databases. This aids the study in attaining reliability and cost-effectiveness as well as providing a longitudinal perspective through secondary data.

2.5 *Review of Previous Studies*

Several research papers have focused on the general relationship between oil prices and stock markets, which formed the basis of this study:

1. Global Evidence:

- Hamilton (1983) showed how oil price shocks have historically caused recessions, which then led to stock markets falling.
- Kilian and Park (2009) show the asymmetric effects of demand-driven and supply- driven oil price shocks on stock returns, and make a case for sectoral analyses.

2. Sectoral Insights:

- Chen et al. (1986), for example, assess sectors' vulnerability to economic forces, including energy prices and found that transportation and manufacturing are particularly sensitive to fuel price changes.
- Jones and Kaul (1996) examined the effect of crude oil prices on stock markets in developed countries and found that the energy sector tends to benefit from rising oil prices.

3. The Case of Pakistan: Empirical Evidence

- Malik and Butt (2013 investigated the effect of oil prices on Pakistan's stock market returns, discovering significant linkages but without a sectoral focus.

- Hanif (2020) focused on the dependency of oil price and stock market despite calling for studies in this field at disaggregate level.

2.6 *Sectoral Analysis of Stock Returns*

The effects of changes in fuel prices differ widely across sectors:

- **Transportation Sector** As the fuel is a significant cost of operations, this sector is highly responsive to prices (Chen et al. 1986).
- **Manufacturing Sector** Higher fuel prices leads to an increase in the production cost resulting in a lower profit margin which in turn depress stock returns (Jones & Kaul, 1996).
- **Energy Sector:** Energy is the market segment that typically profits from higher oil prices, whether through production or distribution (Kilian & Park, 2009).

2.7 *Gaps in Literature*

Although numerous international studies judge the impacts of oil price fluctuations, there is almost no work focusing on the sectoral responses in case of Pakistan. Key gaps include:

1. Lack of impact of empirical studies per the fuel impact of volatility on specific sector for PSX.
2. The scope of sectoral impact analysis has been limited due to the common statistical techniques available in SPSS.
3. The least attention paid to macroeconomic control variables mediating the association between fuel prices and stock returns.

2.8 *Contribution of the Present Study*

This study thus fills these gaps by:

1. Using statistical methods such as T-tests, ANOVA, and regression analysis in SPSS to assess fuel price volatility and its sectoral effects.
2. Adding macroeconomic control variables, for a broad understanding of the relationship.
3. Noting the recent and sector-specific data from the PSX, we are providing actionable insights for investors, policymakers and analysts.

Filling these gaps, this study contributes to the academic literature on the energy economy but also provides important practical tools for decision-making in Pakistan's stock market.

RESEARCH METHODOLOGY

3.1 *Introduction*

This chapter describes the research methodology used for measuring the predictive ability of fuel price volatility on the sectoral stock return in Pakistan. It discusses the research design, data sources, sample selection, data collection procedures, and analytical methods employed in the research. Sample is selected such that it sets procedures to avoid any bias in its results and addresses the research problem.

3.2 *Research Design*

This study uses a quantitative longitudinal design, examining historical stock market data and fuel price fluctuations over a decade-long period (2015–2024). However, the nature of the research is explanatory, and it seeks to determine whether there exists a cause–effect relationship between fuel price volatility and sectoral stock returns in Pakistan.

Statistical techniques such as correlation analysis, regression model and ANOVA are used in order to determine the strength and direction of the relationships between the two factors. Financial markets exhibit various trends over time, thus a longitudinal analysis approach can help capture these trends leading to more reliable and robust results.

3.3 *Population and Sample Selection*

The focus of this study is firms listed on the Pakistan Stock Exchange (PSX) engaged in the transportation, manufacturing, and energy sectors. These sectors were selected because they were directly dependent on fuel and sensitive to its price movements.

Mohr's (2017) purposive sampling technique was used to select 14 companies. Selection criteria include:

- Continuous listing on Pakistan Stock Exchange from 2013 to 2024.
- Full financial data availability.
- Strong reliance on fuel (e.g., transportation companies with large fleets, manufacturing companies with energy-intensive operations and energy companies tied to fuel markets).

3.3.1 *Sector-Wise Firm Selection Energy Sector*

In PSX, energy sector mainly refers to companies

associated with oil, gas and power generation. The selected firms are:

- Oil and Gas Development Company Limited (OGDC) – PKR 871.76 billion market cap.
- Pakistan Petroleum Limited (PPL) – Market cap: PKR 468.77 billion.
- Pakistan State Oil Company Limited (PSO) – Market capitalization: PKR 167.79 billion.
- HUBC – The Hub Power Company Limited – Market cap: PKR 166.14 billion.
- K-Electric Limited (KEL) – Market capitalization: PKR 122.61 billion

Manufacturing Sector

The manufacturing sector includes firms in cement, fertilizers and consumer goods. The selected firms are:

- Lucky Cement Limited (LUCK) – Market cap: PKR 350.35 billion.
- Fauji Fertilizer Company Limited (FFC) – M-Cap: PKR 488.96 billion.
- Colgate-Palmolive (Pakistan) Limited (COLG) – Market cap: PKR 356.48 billion.
- Nestlé Pakistan Limited (NESTLE) – Market cap: PKR 335.36 billion.
- Engro Fertilizers Limited (EFERT) – Market cap: PKR 290.95 billion

Transportation Sector

The transportation sector covers firms in logistics, shipping and automotive. The selected firms are:

- Pakistan International Airlines Holding Company Limited **(PIAHCLA)** – Market cap: PKR 116.16 billion.
- Pakistan National Shipping Corporation (PNSC) – Market cap: PKR 85.03 billion
- Indus Motor Company Limited (INDU) – Mkt Cap: PKR 165.03 billion.
- Atlas Honda Limited (ATLH) – Market cap: PKR 109.41 billion.

3.3.2 *Sample Size*

The dataset captures the data across a temporal span of 120 months (Jan 2015 – Dec 2024) with 2 observations for each month:

- **Observations of Dependent Variable**: 14 firms × 120 months × 2 × 2 = 3,360 observations..
- **Observations of Independent Variable:** : 2 variables × 120 months × 2 values/month = 480 observations.

3.4 *Data Collection Methods*

The study uses multiple secondary data to obtain stock prices and statistics for fuel price indices:

- Stock Returns Data: Monthly adjusted closing prices downloaded from the Pakistan Stock Exchange (PSX) database.
- Fuel Prices: Bi-monthly (1st and 16th of month) records of petrol and diesel prices as published by calls for state energy companies and financial databases.

We cross-validated data from multiple reliable sources to ensure consistency and reduce potential biases.

3.5 *Research Variables*

Dependent Variable:

- Sectoral Stock Returns (Transportation, Manufacturing, Energy)

Independent Variables:

- Fuel Price Volatility (Petrol and Diesel Prices) (Measured by standard deviation of bi-monthly price changes)

3.6 *Data Analysis Techniques*

3.6.1 *Descriptive Statistics*

In addition, basic statistics (mean, median, standard deviation) are computed to characterize the evolution time series of stock returns and fuel prices.

3.6.2 *Correlation Analysis*

Pearson correlation examines the relationship in relation to the sign and intensity among fuel price volatility and stock returns in various sectors.

3.6.3 *Regression Analysis*

For a more quantitative assessment of the productiveness of fuel price volatility:

- Univariate Regression: Studies direct correlations between fuel price volatility and stock returns.
- Multivariate Regression: Analyzes petrol and diesel prices individually to assess their separate influences on stock returns.

Regression Model: $R_{it} = \alpha + \beta 1 Petrol_t + \beta 2 Diesel_t + \varepsilon_t$

Where:

- R_{it} = Stock return for sector **i** at time **t**
- $Petrol_t$ = Petrol price volatility at time **t**

- Diesel$_t$= Diesel price volatility at time **t**
- ε t = Error term

3.6.4 *Analysis of Variance (ANOVA)*

ANOVA is used to test for significant differences in stock returns across sectors in response to changes in fuel prices.

3.6.5 *Robustness Tests*

Further robustness checks (in the form of the tests for stationarity, heteroscedasticity, and multicollinearity diagnosis) are performed so that we can be reasonably assured of the credibility of the results from the regression.

3.7 *Validity and Reliability Measures*

3.7.1 *Internal Validity*

- Correcting the measurement of stock returns and fuel price volatility.
- Double-checking stock price data from several financial databases.
- Employing established statistical techniques to reduce errors and biases.

3.7.2 *External Validity*

- A 10-year dataset strengthens generalizability.
- Sectoral focused, thus applicable to specific sectors in Pakistan.
- Comparability with previous studies allows for generalization of findings beyond the selected sample.

3.7.3 *Reliability*

- Consistent data collection methods provide standardization.
- Regression diagnostics are statistically sound.
- Exploring robustness tests to ensure the stability of results across alternative time periods and data sub-samples.
- Multiple statistical methods used to validate and increase replicability of the results.

FINDINGS

4.1 Results & Interpretations

The exploratory analysis of the data set provides valuable insights regarding statistic of sectorial returns. Returns and volatility of the energy sector differ somewhat. In this sector PSO generates the highest average return (0.74%) with HUBC (0.68%), PPL (0.53%) and OGDC (0.51%) respectively with KEL (0.18%) recording the lowest average return. KEL indicates greatest level of fluctuations with ±8.97% standard deviation, whereas HUBC depicts least volatile landscapes (±5.61%) based on observed data. Returns are highest in KEL (83.68%) which indicates wide price fluctuations followed by HUBC (35.85%) which have stable returns. The 95% confidence intervals suggest that PSO's true mean return is probably between -0.25% and 1.73%, while KEL shows the narrowest confidence range (-0.97% to 1.33%).

Industry-wise, EFERET also leads with a mean return of 1.13% followed by ±4.60% standard deviation, giving the highest, augmented and steady return for the manufacturing sector. LUCK (0.56%) and FFC (0.67%) trail behind, while NESTLE (0.09%) has the least average return. COLG (72.69%) shows the widest range of returns which indicates a high volatility, while EFERET (36.36%) displays the smallest range. According to their confidence intervals, FFC (0.01% to 1.33%) and EFERET (0.54% to 1.72%) return estimate are more accurate, while NESTLE (-0.63% to 0.82%) has the smallest expected return. Return variations are high in the transportation sector. The second highest mean return goes to PIAHCLA (0.77%) while the other stocks, in order of mean return are: INDU (0.83%), ALH (0.74%), PNSC (0.98%) PIAHCLA registers the highest Mean Std. dev. (±13.18%) suggesting significant price volatility while ALH depicts the lowest variance (±6.21%) And since PIAHCLA (127.55%) has the greatest span between its maximum and minimum returns, it implies POAHC likely has an uncertain rate of return. PIAHCLA and PNSC reporting confidence intervals from -0.91% to 2.47 and -0.023 to
2.20 respectively demonstrates uncertainty about their returns, compared to the INDU's interval of -
0.03 and 1.69, which is narrower and therefore a more stable return.

Overall, EFERET & PNSC have the highest mean return in their respective sectors while PIAHCLA & KEL have the highest volatility. These results stress that industries do not carry the same risk-return profile, as certain sectors yield larger returns and more uncertainty than others.

(TABLE 1)

R-square value for PSO is 0.10, showing that petrol prices explain 10% of the variation in returns. Blocking accounts for 0.5% of the variance the adjusted R-square is 0.006 the standard error is 7.82. 95% confidence interval [-2.67, 1.38], p-value = 0.123 => Not meeting statistical significance. The R- square for OGDC is relatively lower with value as low as 0.018 along with an adjusted R-square of
0.013 and standard error of 6.61. The confidence interval is –2.76, 0.68 and the p-value is 0.041, thus statistically significant. Standard error of 7.57, PPL, R-square = 0.011, Adjusted R-square = 0.007. The confidence interval is between -2.82 and 1.09 with a p-value of 0.101, which indicates an insignificant relationship. For HUBC, in particular, it's R-square = 0.012, adjusted-R-square = 0.008, and standard error = 5.70. This gives a confidence interval from -1.87 to 1.08, with a p-value of 0.085, denoting a weak relationship. Both KEL R-square is 0.012, and adjusted R-square is 0.008, and the standard error of 8.86, has a confidence interval of -3.89 to 0.692 and p-value of 0.084, indicating a weak correlation
LUCK R-square ADJ R-square: 0.006 0.002 standard error: 6.96 The 95% confidence interval (-2.14, 1.46) reveals no significant relationship (p = 0.239). FFC exhibits a more notable R-square of 0.038 with an adjusted R-square of 0.034 and standard error of 5.02 at an alpha of 0.05 the confidence interval is -2.45 to 0.14 and the p value (0.002) indicates a statistically significant relationship. The R-square for COLG is 0.002 and the adjusted R-square is negative, at -0.002 (standard error 7.09). Confidence interval: -0.95; 2.72, p (0.475) indicates no significance No way to attach number of observations Ω (8): NESTLE = 0.002 | 0.002 | 6.01 Thus, the confidence interval is (−1.81 to 1.29, p=0.472) which clearly shows non-statistical significance. R-square R-square adjusted standard error EFERET 0.030 0.026
4.53 which corresponds to a confidence interval between − 1.46 and 0.88 and a p-value of 0.007 denoting significance.
In the section of Transportation, the PIAHCLA, has an R-square of 0.017 with an adjusted R-square of
0.013 and an error standard of 13.87. The confidence interval is 1.59 - 5.58 at p = 0.045, indicating a significant although weak association. The R-square, adjusted R-square, and standard error for PNSC are 0.039, 0.035, and 9.29, respectively. Estimates (Cohen's d) were from −4.64 to 0.167 (95% CI), p
= 0.002 (statistical significance). And when it comes to INDU, the R-square is 0.000 with adjusted R- square of -0.004 with standard error of 6.95. Here, the confidence interval shows -1.02 to 2.58, and p- value 0.874 which implicates no statistical significance. ALH with an R-square of 0.010, adjusted R- square of 0.006, and standard error of 6.24. It has a CI of -1.91–1.31 and p = 0.125ñs.
In conclusion, the results indicate that the returns of FFC, EFERET, OGDC, PIAHCLA, and PNSC have a statistically significant association with petrol prices, while the returns of the majority of the other sectors have lower or no correlation.

(TABLE 2)

In contrast, for PSO, the R-square value is 0.028, which indicates that 2.8% of the deviation in returns is accounted for by diesel prices. And, Adjusted r-square: 0.024; Standard Error: 7.75 the value is significant (p = 0.010) (95% CI: -6.29 to -0.06). R-square is 0.025 and adjusted R-square is 0.021 with a standard error of 6.59 for OGDC. The confidence interval of -5.25 to -0.06 with a p-value of 0.015 is statistically significant. For PPL: R-square: 0.021; Adjusted R-square: 0.017; Std. error: 7.53. The confidence interval of -5.80 to -0.25 (p value 0.023) confirmed a statistically significant association.
HUBC: R-square: 0.018118, adjusted R-square: 0.013986, Standard Error: 5.692604. The difference is significant with a confidence interval of -3.83 to -0.75 (p = 0.040). KEL: R-squared: 0.017; adjusted R-squared: 0.013; standard error of 8.83 NOTE: The confidence interval between -6.91 and -0.181 indicates that there is a statistically significant relationship — confirmed by our p-value (0.040).
LUCKR-squared = 0.004; Adjusted R-squared = -0.001; Standard error = 6.97 Confidence interval [−3.44, 2.15], p=0.355, no statistical relationship. FFC has a high R-square of 0.062 (an adjusted R- square of 0.058) and a standard error of 4.96. CI: -5.21 to -1.22; p-value: 0.000 the p-value indicates strong statistical significance. COLG possesses a very low R-square (0.002) and a negative adjusted R- square (-0.002) with a

standard error of 7.09. Confidence interval: -1.58 to 4.11 and p-value (0.485) indicating non-significance. The R-square and adjusted R-square are 0.003 and -0.001, respectively, which leads to a standard error: 6.01. None of them were statistically significant (confidence interval −3.22~1.60, P=0.369) EFERET has R-square =0.025 (adjusted R-square =0.021) and standard error=4.54. Confidence interval = -2.86 to -0.78 P<0.005 confirming the significant relationship Thus, PIAHCLA has R-square = 0.010, Adjusted R-square = 0.006 & Std. Error = 13.92. An analysis between vaccine status and short-term gastrointestinal tract symptoms produced no significant relationship with a confidence-interval of -8.59 to 2.58 and a p value of 0.118. For PNSC, the R- square, adjusted R-square, and standard error are 0.026, 0.022, and 9.35, respectively. The confidence interval is between -7.26 and -0.24 of significant at p = 0.012. INDU R-square is 0.015; adjusted R- square is 0.011; and standard error is 6.90. This beta is also not statistically significant (the confidence interval = -4.41 to 1.16; p=0.061); however, the relationship is weak. ALH - R-square 0.035 Adjusted R-square 0.031 Standard Error 6.16 Confidence interval: −5.16 to −0.21, p = 0.004, a significant relationship

In general, diesel prices appear to have a statistically significant impact on sectorial returns for PSO, OGDC, PPL, HUBC, KEL, FFC, EFERET, PNSC, and ALH, while weak or no relationship is indicated with most of the other sectors. **(TABLE 3)**

Table 1: Descriptive statistic of sectorial returns

Sectors	Returns	Mean	±SD	Median	IQR	Range	95% C.I.
Energy Sector	PSO	0.74	±7.85	0.39	8.79	50.58	-0.25~1.73
	OGDC	0.51	±6.61	0.25	6.86	47.98	-0.33~1.36
	PPL	0.53	±7.60	-0.37	7.44	54.89	-0.43~1.51
	HUBC	0.68	±5.61	0.55	7.09	35.85	-0.03~1.41
	KEL	0.18	±8.97	-0.53	8.40	83.68	-0.97~1.33
Manufacturing Sector	LUCK	0.56	±6.99	-0.18	8.40	44.85	-0.33~1.46
	FFC	0.67	±5.15	0.06	3.88	43.57	0.01~1.33
	COLG	0.29	±7.04	-0.38	6.19	72.69	-0.60~1.20
	NESTLE	0.09	±5.66	-0.06	5.56	41.33	-0.63~0.82
	EFERET	1.13	±4.60	0.61	5.33	36.36	0.54~1.72
Transportation Sector	PIAHCLA	0.77	±13.18	-0.73	10.11	127.55	-0.91~2.47
	PNSC	0.98	±9.49	0.04	8.44	63.00	-0.23~2.20
	INDU	0.83	±6.73	0.36	7.24	53.07	-0.03~1.69
	ALH	0.74	±6.21	-0.09	5.35	53.73	-0.05~1.54

Table 2: Linear Regression between Patrol Prices & Sectorial Returns

Sectors	Models	R- Square	Adjusted R- Square	Std Error	95% C.I.	P-Value
Energy Sector	PSO	0.10	0.006	7.82	-2.67~1.38	0.123
	OGDC	0.018	0.013	6.61	-2.76~0.68	0.041
	PPL	0.011	0.007	7.57	-2.82~1.09	0.101
	HUBC	0.012	0.008	5.70	-1.87~1.08	0.085
	KEL	0.012	0.008	8.86	-3.89~0.692	0.084
Manufacturing Sector	LUCK	0.006	0.002	6.96	-2.14~1.46	0.239
	FFC	0.038	0.034	5.02	-2.45~0.14	0.002
	COLG	0.002	-0.002	7.09	-0.95~2.72	0.475
	NESTLE	0.002	-0.002	6.01	-1.81~1.29	0.472
	EFERET	0.030	0.026	4.53	-1.46~0.88	0.007
Transportation Sector	PIAHCLA	0.017	0.013	13.87	-5.58~1.59	0.045
	PNSC	0.039	0.035	9.29	-4.64~0.167	0.002
	INDU	0.000	-0.004	6.95	-1.02~2.58	0.874

	ALH	0.010	0.006	6.24	-1.91~1.31	0.125

Table 3: Linear Regression between Deisel Prices & Sectorial Returns

Sectors	Models	R-Square	Adjusted R- Square	Std Error	95% C.I.	P-Value
Energy Sector	PSO	0.028	0.024	7.75	-6.29--------0.06	0.010
	OGDC	0.025	0.021	6.59	-5.25~0.06	0.015
	PPL	0.021	0.017	7.53	-5.80~0.25	0.023
	HUBC	0.018	0.013	5.69	-3.83~0.75	0.040
	KEL	0.017	0.013	8.83	-6.91~0.181	0.040
Manufacturing Sector	LUCK	0.004	-0.001	6.97	-3.44~2.15	0.355
	FFC	0.062	0.058	4.96	-5.21~1.22	0.000
	COLG	0.002	-0.002	7.09	-1.58~4.11	0.485
	NESTLE	0.003	-0.001	6.01	-3.22~1.60	0.369
	EFERET	0.025	0.021	4.54	-286~0.78	0.015
Transportation Sector	PIAHCLA	0.010	0.006	13.92	-8.59~2.58	0.118
	PNSC	0.026	0.022	9.35	-7.26~0.24	0.012
	INDU	0.015	0.011	6.90	-4.41~1.16	0.061
	ALH	0.035	0.031	6.16	-5.16-------0.21	0.004

5.1 Discussion

The current study focus on three main sectors: namely transportation, manufacturing and energy to examine the predictive power of fuel price volatility over sectoral stock returns in Pakistan. The analysis demonstrates that fuel price volatility has a significant bearing on stock returns among various sectors, albeit the nature of the impact varies across different sectors. In the discussion below, we compare these findings in detail with existing research and theoretical constructs.

Of fuel price fluctuations, which indicates that the transportation sector is highly sensitive. Through our regression analysis we find that PNSC had an R-square value of 0.039 and a p-value of 0.002 which implies that there is a statistically significant relationship between fuel prices and stock returns. PIAHCLA also had an R-square of 0.017 and p-value 0.045, indicating a weak but significant positive association. These results are in line with findings from previous studies [e.g., Chen et al. (1986) and Sadorsky (1999), who stated that fuel prices significantly affect transportation firms, as they rely extensively on petroleum products in order to operate. High stdev of return in transportation sector—which has highest stdev of return on both PIAHCLA (±13.18%) — highlighted in table above suggest that higher the volatility of fuel prices higher the volatility of returns. This finding is consistent with Malik and Butt (2013) which found a significant relation between oil price changes and stock market returns in Pakistan.

The manufacturing sector was more of a mixed bag. 7.07.8 Some of the firms, including EFERET (R- square = 0.030, p-value = 0.007) and FFC (R-square = 0.038, p-value = 0.002), had a significant relationship with fuel price volatility, while others, such as NESTLE (R-square = 0.002, p-value = 0.472) and COLG (R-square = 0.002, p-value = 0.475), did not. The result indicates that the effect of fuel price changes on manufacturing firms is a function of production and operational costs structure. Fuel-intensive industries like cement and fertilizer are harder hit so far than consumer goods manufacturers. The finding lends support to Jones & Kaul (1996) in their observation that the effect of oil prices on manufacturing firms depends crucially on their input of fuel.

In particular, the energy industry exhibited a decent correlation of 0.82 with price change, with PSO, OGDC, and PPL leading the pack. The findings indicate that the R-square value for PSO was 0.028 with a p-value of 0.010, reflecting that diesel price variations explain about 2.8% of the variations in stock returns. Likewise, the relationships between OGDC and CP (R-square = 0.025, p-value = 0.015), as well as those between PPL and CP (R-square = 0.021, p-value = 0.023), proved statistically significant. These results are consistent with Kilian and Park (2009), who highlighted that energy firms typically gain from rising oil prices due to a higher profit

margin when producing oil and gas. In the energy sector, the standard deviation of returns, for KEL (±8.97%) and PSO (±7.85%), also reveals that significant price change in company fuel has great influence on returns.

A clear insight from this analysis is that even if fuel price volatility is a predictor for stock returns in some sectors, its explanatory power remains moderate. R-square values obtained from the regression models vary between 0.017 and 0.062 in the different sectors, indicating that there are another macroeconomic variables explaining movements on the stock market. This result is in line with the previous literature, in particular with Malik and Butt (2013) that claimed that although oil prices do affect stock markets but for a holistic picture other factors such as exchange rates, inflation and interest rates require to be analyzed too. These findings also provide partial support for the Efficient Market Hypothesis (Fama, 1970) since the information related to fuel price is reasonably incorporated into stock prices with the presence of ineffectiveness in the market with slow adjustments.

In general the discussion shows firms in the energy and transport sectors see high leverages of good and bad news on fuel returns while manufacturing returns show a disparity.

6.1 *Conclusion*

The aim of this study was to investigate the predictive power of Fuel price volatility on sectoral stock return in Pakistan specifically in transportation, manufacturing and energy sector. Given the above explanation, the central issue is the empirical evidence on the sectoral impacts of fuel price changes and whether these results are useful when making investment decisions. The main results suggest that the transport and energy sectors are most sensitive to the volatility of fuel prices, while the manufacturing sector shows mixed evidence. The transportation sector, represented in the study by PNSC and PIAHCLA, demonstrated a high degree of correlation with changes in fuel prices, supporting existing literature: fuel-dependent firms are prone to price shocks. Likewise, the energy companies like PSO, OGDC, and PPL found highly significant association with fuel price volatility, reiterating findings of global studies that claim energy firms are among the beneficiaries of increasing fuel prices. Yet the disparate results found in the manufacturing sector show that firm-specific aspects, as well as industry- wide operational dynamics, need to be accounted for.

These results have significant consequences for investors, policymakers, and corporate gatekeepers. Trends of fuel pricing must be a factor in portfolio strategies in equity and mutual fund investment where industries sensitive to fuel pricing are involved. Fuel price hikes are compelling policymakers to acknowledge the economic repercussions and consider regulatory actions, such as fuel subsidies or investments in alternative energy, to buffer vital sectors. Risk mitigation strategies at the company level would include hedging for fuel price volatility or investing in energy-effective technology for companies in most affected industries.

While these findings are informative, this study has its limitations, particularly the lack of consideration for other macroeconomic variables, like interest rates, inflation, and exchange rate fluctuations, which could be vital drivers in stock return volatility. In addition, this study was focused on three sectors, and future studies should explore various industries in the Pakistan Stock Exchange to offer a more comprehensive market dynamics exploration. Future research could potentially build on this, incorporating qualitative factors like investor sentiment, firm-level governance and so to improve prediction accuracy. Future studies should also implement advanced econometric methods in order to develop better forecasting models, as well as establish more robust causal relationships between fuel prices and stock returns.

This study provides important information and reinforces that the role played by fuel price volatility matters in stock price dynamics in emerging economy like Pakistan. Although the results are useful, ongoing research is required to reflect changing economic conditions and market structures. This interaction comes into play when assessing the risk-adjusted stock performance, relevant for making well-informed financial and policy-related decisions in the regard, which are vital towards establishing a stock market system that is more resilient and efficient.

6.2 *Recommendations*

- Fuel price trends should also be included in risk assessment models, especially in highly correlated sectors including transport and energy.
- Investment strategies should be modified to account for fuel price volatility effects on portfolios, enabling superior diversification.
- Policymakers need to regulate or invest in alternative energy to stabilize fuel prices and mitigate negative impacts on sensitive sectors from fuel price volatility.
- Targeted subsidies or fuel price adjustment mechanisms to protect cost-sensitive industries could be introduced.
- Corporations, especially in transportation, need to invest in energy-efficient technologies and alternative fuels to move away from unpredictable fuel markets.
- Investors need to incorporate fuel price trends into the risk models they use to manage financial risks related to fuel price fluctuations, especially for sensitive sectors like transportation and energy Acronyms for American Fuel Index and American Oil Index in compliance with investment strategies would account and better diversify portfolios against oil and diesel price volatility. Regulatory measures or investment in alternative energy can stabilize fuel prices, while targeted subsidies could protect vulnerable industries. Second, corporations—especially in transportation—need to follow the lead of manufacturers in adopting energy-efficient technologies and alternative fuels to reduce their dependence on volatile markets for energy. Hedging strategies also can help further stabilize the performance of this stock.

6. *3 Limitations*

- The research is based on a limited number of premier companies in three sectors which may not represent the entire Pakistan Stock Exchange.
- In order to ensure more generalizable findings, future studies should widen its scope by including a more diverse sector and companies.
- Other macroeconomic factors, including inflation, interest rates, exchange rate fluctuations, and geopolitical risks, are not included in this study which could immensely influence stock returns.
- Future studies should use these factors together in predictive models.
- Data limitation: study period is ten years versus the historical (long term) data analysis would give a better picture of the results. Researches do not analyze qualitative factors that play a significant role in stock price, including corporate governance, firm-specific policies, and investor sentiment, these qualitative factors can be incorporated in future studies to make it easier to understand stock market. The study is limited to a few companies from three sectors; therefore it may not portray the overall trends of Pakistan stock exchange. Subsequent research should encompass a broader spectrum, sampling from a wider variety of sectors and companies, so that conclusions are more generalizable. Furthermore, this study excludes other macros, including inflation, interest, currency fluctuations and even geopolitical risk, all of which could have major effects on the return of stocks. Increased research should combine cause to better predictive models. The study covers a ten year period which grounds analysis in a very solid timeframe but a longer historical dataset could further bolster the results. Additionally, qualitative factors—including corporate governance, firm-specific policies, and investor sentiment—were not analyzed, and including such variables in future research may provide greater insight concerning stock market dynamics

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