

# The Impact of Interest Rate Changes on Stock Volatility Across Different Sectors

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## ABSTRACT

Interest rates are one of the most important channels through which monetary policy affects financial markets, but their effect is unlikely to be uniform across sectors. Firms in technology, energy, financial services, real estate, consumer staples, and health care differ in their financing needs, duration of expected cash flows, cyclical exposure, and investor clientele. These differences suggest that a common change in the federal funds rate may create different patterns of stock price volatility across sector portfolios. This paper investigates the impact of interest rate changes on sector-level stock volatility in the United States from 2019 to 2024. The study combines monthly Federal Funds Effective Rate data with daily price histories for six Select Sector SPDR exchange-traded funds: XLE, XLF, XLK, XLP, XLRE, and XLV. Daily log returns are calculated from ETF closing prices and then aggregated into monthly realized volatility measures. The empirical analysis uses descriptive statistics, correlation analysis, and sector-by-sector multiple linear regressions in which monthly volatility is explained by the level of the federal funds rate, monthly changes in the rate, and lagged volatility. The results show that sector volatility is heterogeneous even under the same interest rate environment. Energy and technology display the highest average volatility, while consumer staples and real estate show lower average volatility in the sample. Regression results suggest that interest rate variables help explain sector volatility, although the estimated relationships have different magnitudes and levels of statistical significance across sectors. The paper contributes to the literature by connecting monetary policy transmission with sector-level risk and provides practical implications for investors who use sector allocation to manage exposure to changing interest rate conditions.

**Keywords:** Interest Rates; Stock Volatility; Sector ETFs; Monetary Policy; Sector Heterogeneity

## 1. INTRODUCTION

Interest rates play a central role in modern financial markets because they connect monetary policy, credit costs, corporate investment, asset valuation, and investor risk preferences. When the Federal Reserve changes the policy rate, the adjustment affects borrowing costs for households and firms, discount rates used in equity valuation, and the relative attractiveness of risky assets compared with fixed-income instruments. For this reason, equity markets often react strongly to changes in interest rate expectations. The Federal Funds Effective Rate is therefore not only a policy variable but also a key market signal that influences the pricing of stocks and the level of risk perceived by investors.

However, the stock market is not a single homogeneous asset. Sectors have different balance sheet structures, growth opportunities, sensitivity to credit conditions, and exposure to the business cycle. Technology firms are often valued on long-term expected cash flows and can be sensitive to changes in discount rates. Financial firms are directly connected to interest margins and credit conditions. Real estate firms and REITs are affected by capital costs and property financing. Energy firms are influenced by commodity markets as well as macroeconomic conditions. Consumer staples and health care may be relatively defensive because demand for their products is less cyclical. These differences create a clear reason to examine the impact of interest rate changes at the sector level rather than only through a broad market index.

The research question of this paper is: how do changes in interest rates affect stock volatility across different sectors? The paper addresses this question by using daily price data for six sector exchange-traded funds and monthly federal funds rate data. The analysis focuses on volatility rather than only returns because volatility captures the risk and uncertainty faced by investors. A sector may not have a large average return response to interest rates, but it may become substantially more unstable when monetary policy conditions change.

## 2. LITERATURE REVIEW

A broad stream of research studies how monetary policy affects equity markets. Prior work shows that expansionary monetary policy is associated with higher stock returns, that unexpected policy changes can be measured through federal funds futures, and that monetary policy surprises affect stock prices through expected excess returns and expected future dividends <sup>[1][2][3][4]</sup>. These studies provide the theoretical basis for treating interest rate changes as an important channel of stock market valuation and risk transmission.

The second relevant stream of literature focuses on volatility and market risk. Financial crises and macroeconomic stress are closely connected with higher stock volatility, while ARCH and GARCH models remain foundational tools for explaining time-varying volatility <sup>[5][6][7]</sup>. More recent empirical studies also show that investor sentiment and market shocks can influence volatility differently across market settings <sup>[8][9]</sup>.

Sector-level studies further support the need for sector comparison. Research on oil-gas stocks, oil-based economies, pandemic uncertainty, and U.S. REITs shows that energy, real estate, and other sector portfolios can react differently to macro shocks, monetary policy, and uncertainty <sup>[10][11][12][13]</sup>. Their findings motivate this paper's focus on cross-sector volatility rather than a single aggregate market index.

Overall, the existing literature establishes that monetary policy and macroeconomic shocks affect stock prices and volatility. It also shows that sectors may react differently to common shocks. Nevertheless, many studies either focus on the broad stock market or on one sector. There remains room for a compact empirical comparison of several major U.S. sector ETFs under the same interest rate environment. This paper addresses that gap by comparing the volatility sensitivity of energy, financials, technology, consumer staples, real estate, and health care sector ETFs from 2019 through 2024.

## 3. DATA AND METHODOLOGY

The empirical analysis uses two types of data. The interest rate variable is the monthly Federal Funds Effective Rate, collected in the local file FEDFUNDS.csv <sup>[14]</sup>. The FRED series describes this rate as the effective federal funds rate in percent, not seasonally adjusted, with monthly frequency based on averages of daily figures. The stock data consist of daily price histories for six sector ETFs: XLE for energy, XLF for financials, XLK for technology, XLP for consumer staples, XLRE for real estate, and XLV for health care. The ETF files cover the period from early January 2019 to the end of December 2024, while the federal funds rate data cover January 2019 to December 2024. The ETF selection follows the Select Sector SPDR sector classification <sup>[15]</sup>.

The sector ETFs are used because they provide transparent and tradable proxies for sector portfolios. Instead of selecting individual firms, which would introduce firm-specific noise, sector ETFs summarize the performance of groups of companies within each sector. This makes them appropriate for a study that is concerned with sector risk rather than individual stock risk. The six ETFs are selected using three criteria: they belong to the Select Sector SPDR family, they have complete local daily price histories for the 2019-2024 sample window, and together they represent economically distinct sector types related to interest rate transmission. These include cyclical energy and financials, growth-oriented technology, defensive consumer staples and health care, and interest-sensitive real estate. The coverage is therefore intentionally limited. The sample contains six sector ETFs rather than every Select Sector SPDR or GICS sector, so the findings should be interpreted as evidence for the included sectors and not as a complete map of the entire U.S. equity market.

The first step in the data processing is to sort each ETF price series by date and calculate daily log returns, defined as the natural logarithm of the current closing price divided by the previous trading day's closing price. Let  $P_{i,d}$  be the closing price of sector ETF  $i$  on trading day  $d$ ,  $r_{i,d}$  be its daily log return,  $t$  be a calendar month, and  $N_t$  be the number of valid trading days for that ETF in month  $t$ . Monthly return and monthly realized volatility are calculated as follows.

$$r_{i,d} = \ln \left( \frac{P_{i,d}}{P_{i,d-1}} \right) \quad (1)$$

$$R_{i,t} = \sum_{d=1}^{N_t} r_{i,d} \quad (2)$$

$$\text{Volatility}_{i,t} = \sqrt{N_t} \cdot \sqrt{\frac{\sum_{d=1}^{N_t} (r_{i,d} - \bar{r}_{i,t})^2}{N_t - 1}} \quad (3)$$

In these formulas,  $R_{i,t}$  is the monthly log return of sector ETF  $i$  of month  $T$ .  $\bar{R}_{i,t}$  is the average value of daily log return for that month.  $\text{Volatility}_{i,t}$  is the actual volatility of each month. Return and volatility are saved in decimal log-return. For example, 0.05 roughly represents 5%. These values are expressed as percentages in table and figure. The monthly return is calculated in the process of sorting out the data, but the published table focuses on volatility. Because empirical problems are more related to the risk of sector than the average return performance.

The daily return is divided into calendar months. Then the monthly volatility series matches the monthly federal funds rate series. Monthly consolidation is used because it conforms to the frequency of FEDFUNDS data. In addition, it can reduce the noise from each trading day while maintaining the meaningful change of sector level risk. Baseline regression is calculated separately for each sector. The goal variable is to realize volunteers every month. Descriptive variables are the level of federal funds rate, the monthly change of federal funds rate and a lag of sector volunteers. The reason why there is a resistance term is because the resistance of the stock market is continuous. In other words, the period of high enthusiasm often lasts until the next month. The regression model can be written as follows:  $\text{Volatility}_{i,t} = \alpha_i + \beta_1 \text{FedFunds}_t + \beta_2 \text{ChangeFedFunds}_t + \beta_3 \text{Volatility}_{i,t-1} + \text{error}_{i,t}$ . By calculating the model separately for each sector, the coefficients of each sector can be made different. In this way, we can directly compare the susceptibility of interest rates.

#### 4. EMPIRICAL RESULTS AND DISCUSSION

This section introduces the actual data obtained from the monthly sector panel. Firstly, it starts with descriptive statistics, then compares the low interest rate term with the high interest rate term, and finally releases the sector-level regression. The main purpose is to determine whether each sector has the same volatility mode, or whether each sector's response to risk is different according to the interest rate.

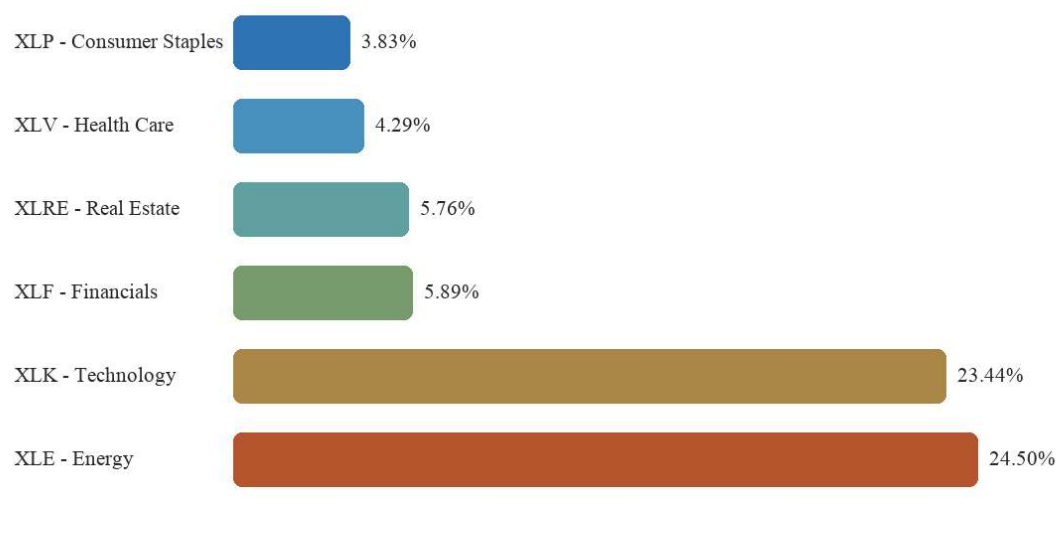
The neatly arranged panel contains the monthly observation data from 2019 to 2024 for each of the six sector ETF. Table 1 contains the basic statistics of sector volatility every month. Specifically, the number of monthly observation data, the average value of monthly realized volatility, the central value of monthly realized volatility, the maximum value of monthly realized volatility and the average value of annual converted volatility are not recorded in Table 1. Because return is only used to calculate volatility, it is not used as a variable to represent the result in future analysis. As can be seen from the results, each sector has obvious differences. The average monthly volatility of energy and technology in the sample is the highest, while the average monthly volatility of consumer staples and real estate is smaller.

Table 1. Monitor security volume description statistics.

| Ticker | Sector           | Months | Avg. monthly vol. | Median monthly vol. | Max monthly vol. | Avg. annualized vol. |
|--------|------------------|--------|-------------------|---------------------|------------------|----------------------|
| XLE    | Energy           | 72     | 24.50%            | 7.38%               | 198.51%          | 80.34%               |
| XLK    | Technology       | 72     | 23.44%            | 6.10%               | 198.78%          | 76.84%               |
| XLF    | Financials       | 72     | 5.89%             | 4.87%               | 34.30%           | 20.08%               |
| XLRE   | Real Estate      | 72     | 5.76%             | 4.99%               | 31.02%           | 19.72%               |
| XLV    | Health Care      | 72     | 4.29%             | 3.55%               | 24.10%           | 14.69%               |
| XLP    | Consumer Staples | 72     | 3.83%             | 3.15%               | 23.61%           | 13.08%               |

Note: Values are based on monthly observations from January 2019 through December 2024 and are reported as percentages.

Figure 1 compares the average monthly volatility of each sector ETF. By looking at the arrangement of this chart, you can see that the impact of market uncertainty is not the same in sector. This fact is very important and becomes the reason for every sector to conduct research. If all sector are equally volatile, then a broad market index is enough. But in fact, depending on the sector portfolio you have, you can see that the size of investor's risk is different.



Source: Author calculations using local ETF price files.

Figure 1. Average Monthly Realized Volatility by Sector ETF.

Note: the author uses the data of local ETF price to calculate.

Table 2 compares the average volatility of low rate months and high rate months. Median example relative to federal funds rate. This is not to say that the middle value will change the relationship, but to simply compare the risk of the sector with different interest rate environments. In this example, in all six sector ETF, the average volume of high rate months is smaller than that of low rate months. Mainly because the market of COVID-19 was hit hard when the interest rate was very low. It can be seen that the impact of interest rates needs to be considered together with the broad macroeconomic situation.

Table 2. Average Volatility Under Lower-Rate and Higher-Rate Months.

| Ticker | Sector           | Low-rate vol. | High-rate vol. | Difference |
|--------|------------------|---------------|----------------|------------|
| XLP    | Consumer Staples | 4.43%         | 3.22%          | -1.21%     |
| XLRE   | Real Estate      | 6.39%         | 5.13%          | -1.26%     |
| XLV    | Health Care      | 5.04%         | 3.55%          | -1.50%     |
| XLF    | Financials       | 7.33%         | 4.44%          | -2.89%     |
| XLK    | Technology       | 40.83%        | 6.04%          | -34.79%    |
| XLE    | Energy           | 42.85%        | 6.14%          | -36.71%    |

Note: The month of higher rate depends on the median example of federal funds rate.

Figure 2 depicts “average safety” and “federal basal rate” together. The easiest thing to understand is that when the market shock in early 2020, volatility rose sharply, while the federal funds rate quickly dropped to the vicinity of zero lower bound. In the latter, because of the pressure of inflation, the federal funds rate rises sharply, but the volatility of each sector is still very fragmented. From this process, we can see why we should put the size and change of rate into regression analysis, and then consider the previous volatility.

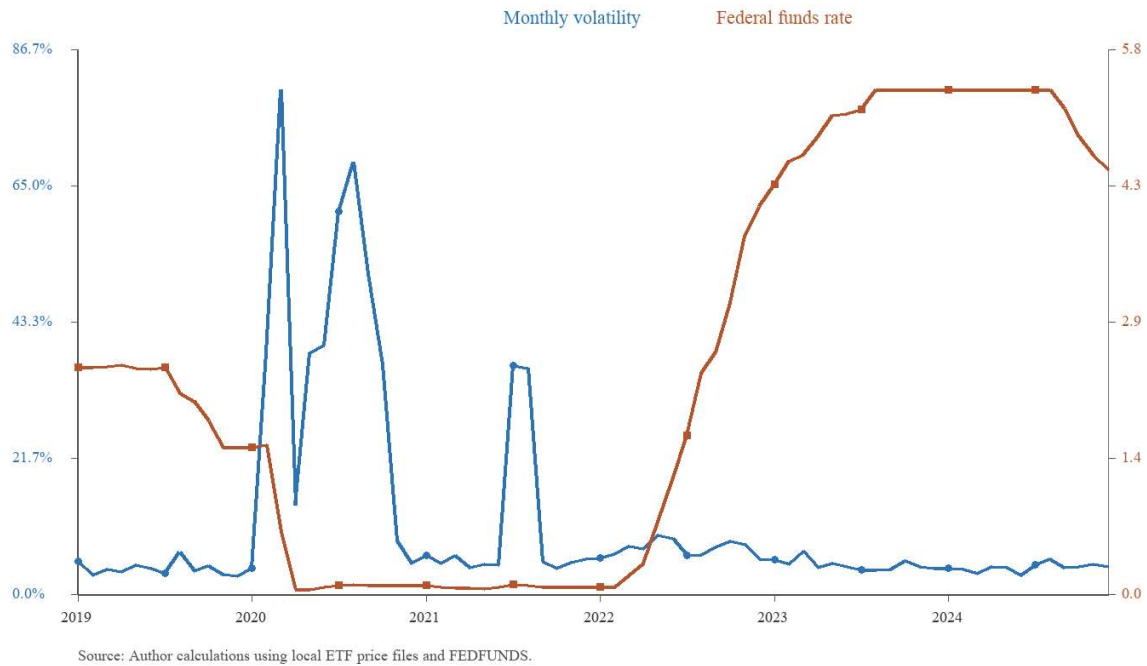


Figure 2. Average Sector Volatility and the Federal Funds Rate Over Time.

Note: This is calculated by the author using FEDFUNDS and local ETF price file.

Looking at the correlation results of Table 3, we can first understand the relationship between the elements of interest rate and sector volatility. Correlation is not a number of cause and effect, but it helps you to see whether the relationship between different sector is similar or different. Each sector has a different symbol and size. This is in line with paper's main proposition: "to understand how the change of interest rate is transmitted to the stock market, the deviation of sector is very important."

Table 3. Relationship between interest rate variables and sector instability.

| Rate variable | XLE    | XLF    | XLK    | XLP    | XLRE   | XLV    |
|---------------|--------|--------|--------|--------|--------|--------|
| fedfunds      | -0.411 | -0.360 | -0.389 | -0.231 | -0.153 | -0.286 |
| rate_change   | -0.255 | -0.398 | -0.243 | -0.355 | -0.318 | -0.381 |

Note: Correlations are calculated at monthly frequency.

Table 4 reports sector-by-sector regression results. The federal funds rate coefficient measures how monthly volatility is associated with the level of interest rates after controlling for monthly rate changes and lagged volatility. The rate-change coefficient captures whether a month-to-month movement in rates is associated with higher or lower volatility. The lagged volatility coefficient is generally positive, reflecting persistence in market risk. Using  $|t| \geq 1.96$  as a conventional benchmark, the monthly rate-change coefficient is statistically significant for XLRE - Real Estate, XLP - Consumer Staples, XLV - Health Care, XLF - Financials, but not for XLK - Technology, XLE - Energy. No federal-funds-rate level coefficient reaches that benchmark; those coefficients should be read as descriptive associations rather than established effects.

Table 4. Sector Regressions of Monthly Volatility on Interest Rate Variables.

| Sector                 | N  | Fed funds beta | t     | Rate change beta | t     | R-sq. |
|------------------------|----|----------------|-------|------------------|-------|-------|
| XLRE - Real Estate     | 71 | -0.0008        | -0.45 | -0.0437          | -2.68 | 0.336 |
| XLP - Consumer Staples | 71 | -0.0017        | -1.21 | -0.0350          | -2.73 | 0.221 |

Table 4. (continued) Sector Regressions of Monthly Volatility on Interest Rate Variables.

| Sector            | N  | Fed funds beta | t     | Rate change beta | t     | R-sq. |
|-------------------|----|----------------|-------|------------------|-------|-------|
| XLV - Health Care | 71 | -0.0021        | -1.45 | -0.0383          | -3.02 | 0.294 |
| XLF - Financials  | 71 | -0.0042        | -1.95 | -0.0591          | -3.19 | 0.335 |
| XLK - Technology  | 71 | -0.0261        | -1.29 | -0.0920          | -0.52 | 0.494 |
| XLE - Energy      | 71 | -0.0273        | -1.36 | -0.1123          | -0.64 | 0.512 |

Note: Each regression includes the federal funds rate, the monthly rate change, and lagged volatility. Coefficients with absolute t-statistics below about 1.96 should not be interpreted as statistically established effects.

The empirical results should be interpreted with appropriate caution. The sample period includes the COVID-19 market shock, the zero-rate period, and the rapid tightening cycle after 2022. These events make the sample economically meaningful, but they also mean that the interest rate variable is correlated with broader macroeconomic conditions. The regression therefore identifies associations rather than a fully causal monetary policy shock. A more advanced study could use high-frequency monetary policy surprises or a structural VAR design. Nevertheless, for a sector-level first draft, the present results provide useful evidence of cross-sector differences in average volatility and of different magnitudes and levels of statistical significance in the estimated rate-volatility associations.

## 5. CONCLUSION

This paper studies how changes in interest rates affect stock volatility across different sectors by combining monthly federal funds rate data with daily price histories for six U.S. sector ETFs from 2019 to 2024. The analysis shows that sector volatility differs substantially across sectors and that the relationship between interest rate variables and volatility is not uniform. Energy and technology show the highest average volatility in the sample, while consumer staples and real estate show lower average volatility. Regression results show different magnitudes and levels of statistical significance. Monthly rate changes are statistically significant for financials, health care, consumer staples, and real estate using the conventional  $|t| \geq 1.96$  benchmark, while the rate-change coefficients for energy and technology and the federal-funds-level coefficients for all sectors are not statistically established at that benchmark. The main conclusion is that interest rate transmission through the stock market should be understood not only at the aggregate market level but also through the lens of sector heterogeneity. For investors, this means that sector allocation can be an important tool for managing interest rate risk, although non-significant coefficients should not be treated as confirmed sector effects. For policymakers, it means that monetary policy may create uneven risk effects across sectors. Future research can extend this study by adding more sectors, using monetary policy surprise measures, applying GARCH or VAR models, and comparing U.S. results with other markets.

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