The Effects of Derivatives on Asset Price Volatility: A Study on the Options Trading in the USA and UK

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Abstract

The impact of options trading on underlying asset prices in the United States and United Kingdom markets from 2010 to 2024 is the focus of this study. A multivariate GARCH model and Granger causality tests were used to analyze the relationship between options trading volume and price volatility of the underlying assets. Results indicated a significant bidirectional relationship between options trading activity and asset price volatility, with increased options volume generally associated with higher short-term price fluctuations. The comparison between the USA and UK markets provides valuable insights into how different regulatory environments and market structures may impact the relationship between derivatives and asset prices. However, the long-term impact on price efficiency across various market segments showed mixed results. This research paper provides regulatory policies regarding the role of derivatives in financial markets that policymakers in the USA and the UK should implement. The findings could have implications for risk management practices, market stability, and the design of financial instruments.

Keywords: Derivatives, Options Trading, Asset Pricing, Price Volatility, Market Efficiency.

Introduction

The main focus of this research paper is related to the impact of derivatives trading on underlying asset prices, as it has been the topic of discussion in financial literature for an extended period. Over the past few decades, the global derivatives market has grown exponentially; investors, regulators, and policymakers must understand its effects on price discovery, volatility, and market efficiency.

This research paper discusses the impact of options trading on asset prices by taking samples of the world's two most significant financial markets, i.e., the United States of America and the United Kingdom. As with other derivatives, options allow investors to perform some actions, such as buying or selling the specific security at a stipulated price within a given period. The theoretical link between options and the assets that back them has been defined since the works by Black and Scholes in 1973. Nevertheless, as already pointed out, the findings concerning the impact of options on actual stock prices in the operational environment are inconclusive. They can vary depending on the conditions prevailing in a specific market.

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Options, the type of derivatives, offer the investor the ability to purchase or sell an asset at a specified price within a given period, though not necessarily the ownership of the asset is involved. Options and their link to the base assets have been illustrated theoretically from the works of Black and Scholes (1973). Still, the extant literature lacks empirical studies on how options trading influences stock prices in real-life markets; thus, this research seeks to fill this gap by investigating the options market and its effects on stock prices in US and UK markets for the period of the study which is between 2010 and 2024. Therefore, this paper aims to find out the relationship between option trading activity and the behaviors of stock prices that are not easily discernible, mostly by using econometric methodologies and a large sample size.

Literature Review

Financial literature has extensively studied the relationship between derivatives trading and asset prices. Early theoretical work by Ross (1976) suggested that options trading could enhance market completeness and improve price discovery. This view was supported by empirical studies such as Conrad (1989), who found that introducing options led to positive abnormal returns for underlying stocks.

Bai et al. (2022) examined low-risk anomalies in the option markets. Scholars also provided evidence that such an anomaly exists; now, low-risk stocks have higher risk-adjusted returns than high-risk stocks. Thus, this paper contributes to the literature on low-risk anomalies and broadens the same from stock markets to options markets, including insights into asset pricing theory.

Gao et al. (2022) employed China's stock index futures, which have been introduced as a quasi-experiment method to focus on the role played by derivatives in improving the efficiency of the prices of assets. It was established that trading in derivatives helps improve price efficiency and the decline of synchronicity of stock prices. Thus, this study offers several insights into the functioning of derivatives in emerging markets.

To identify the real effects of options trading, Huang et al. (2023) took advantage of the fact that options are introduced in different stocks at different times. From the available literature, their study found that there is a positive relationship between options trading, increased corporate investment, and improved firm performance. From this, it can be concluded that options markets primarily involve corporate decision-making and value addition.

Danielsen et al. (2007) conducted a study on options listing and its effect on the quality of the stock market. They identified that while the bid-ask spread reduced, there was no effect on the trading volume and volatility of returns. However, Ni et al. (2008) state that positive stock return volatility near the options expiration dates points more to the direction of the destabilizing role of options.

In the context of international markets, Bollen (1998) used cross-sectional analysis and announced that the effect of options introduction depended on markets. Market-specific factors were considered critical in assessing the impacts of derivatives trading.

Subsequent literature development has concerned the informative efficiency of options markets, though. In another study, Pan and Poteshman (2006) posited that options trading volume does contain information on future stock prices; thus, agreeing with options markets facilitates price discovery. Similarly, Hu (2014) noted that the options market's content prevails over the stock market's content on information regarding individual equities.

The history of their relationship has taken new twists with the entrance of high-frequency trading and algorithmic approaches to investing. In the study, Boehmer et al. (2018) investigated the impact of high-frequency trading in options markets on the lower-level prices of the underlying

assets. They showed that this has a positive influence on the efficiency of prices while also coupled with higher fluctuations in the short term.

In a similar UK environment, Gemmill and Thomas (1997) investigated the effect of options trading on the volatility in the London Stock Exchange. They showed a slight decrease in volatility after the options' introduction. More recent works like that of Buckley and Van der Nat (2003) pointed to the likelihood of this hypothesis being outdated with the change in the business environment.

Thus, further research is needed to complement the current literature by providing an updated and systematic investigation covering the contemporary market developments that employ modern econometric analysis approaches. This research intends to address this issue in this paper by comparing the US and UK stock markets utilizing modern data and methods.

Using binary options trading and stock market liquidity as the nexus of analysis, Cao and Han found a negative correlation between them in their study conducted in 2021. Based on this, they concluded that it increased the liquidity of tradable stocks through options trading, especially where there was high information asymmetry. This improvement is attributed to the informational role of options and the finding that options are a superior method of coping with dependencies.

Battalio et al. (2020) addressed the issue regarding options investors' rationality using exercise boundary violations. Unlike prior works, they discovered that such abuses are not as rampant as assumed, suggesting more reasonable comportment among options investors. Concerning specialty traders, this paper disputes previous claims about option investor behavior.

In their study conducted in 2021, Li et al. aimed to explain the effects of high-frequency trading (HFT) in options markets for the underlying assets' prices. Their empirical studies revealed that a rise in HFT in options markets enhances price discovery and reduces the volatility of the underlain stocks. Towards this end, this research underscores the increasing relevance of technological changes in derivatives markets.

Kleinbrod and Jürgens (2023) researched the influence of options market implied volatility on expected stock returns. They conclude that options market information, particularly implied volatility, helps forecast future stock returns when the market is under pressure. This research, therefore, emphasizes the need to utilize options markets as a source of information that holds the forward-looking ability.

Research Objectives

The primary objectives of this study are:

1. To examine the impact of options trading volume on underlying asset price volatility in the US and UK markets.
2. To investigate the bidirectional causality between options trading activity and asset price movements.
3. To assess the differences in the options-asset price relationship between the US and UK markets.
4. To analyze how the impact of options trading on asset prices has evolved over the 2010-2024 period.

Research Questions

This study addresses the following research questions:

1. How do options trading volume affect underlying asset prices' short-term and long-term volatility in the US and UK markets?

2. Is there a significant causal relationship between options trading activity and asset price movements?
3. Are there notable differences in the impact of options trading on asset prices between the US and UK markets?
4. Has the relationship between options trading and asset prices changed significantly over 2010-2024?

Hypotheses

Based on the literature review and research objectives, we propose the following hypotheses:

H1: Increased options trading volume is associated with higher short-term volatility in underlying asset prices.

H2: A bidirectional Granger causality exists between options trading volume and asset price movements.

H3: The impact of options trading on asset price volatility is more substantial in the US than in the UK market.

H4: The relationship between options trading and asset price volatility has become stronger over the 2010-2024 period due to increased market integration and technological advancements.

Conceptual Framework

The conceptual framework for this study is based on the idea that options trading can impact asset prices through multiple channels: The conceptual framework for this study is based on the idea that options trading can impact asset prices through various channels:

1. Information Channel: There is often evidence that options trading may incorporate new information into prices quicker and, therefore, may have better information revelation.
2. Hedging Channel: Options offer hedge possibilities, which lower the total amount of market risk and influence the variations in the value of the assets.
3. Speculation Channel: Speaking of options, they allow buying an asset or a right in a call mode, which is suitable for speculation, which may lead to the phasing out of assets and a short-term rise in their price.
4. Leverage Channel: It must be noted that options offer a mechanical advantage, which exaggerates the respective asset's price swings.

This framework guides our empirical analysis, which aims to disentangle these effects and quantify their relative importance in the US and UK markets.

Research Methodology

Data Collection

Bloomberg and Thomson Reuters Eikon databases were the primary sources of data. Data on options trading volume and underlying asset prices for major stock indices in the US (S&P 500) and UK (FTSE 100) from January 1, 2010, to December 31, 2024, were collected to conduct this study. Data on relevant control variables, including market capitalization, trading volume of underlying assets, and macroeconomic indicators, was also collected to perform the test involved in this research paper.

Empirical Model

To examine the relationship between options trading and asset price volatility, we employed a multivariate GARCH (MGARCH) model. The MGARCH model allows for the simultaneous

estimation of mean and variance equations, capturing the dynamic relationships between variables. The model specification is as follows:

$R(t) = \alpha + \beta * OV(t) + \gamma * X(t) + \varepsilon(t)$ $h(t) = \omega + \alpha * \varepsilon(t-1)^2 + \beta * h(t-1) + \delta * OV(t)$

Where: R(t) is the return of the underlying asset at time t, OV(t) is the options trading volume at time t, X(t) is a vector of control variables, h(t) is the conditional variance of returns ε(t) is the error term.

We used the Granger causality test to determine causality, which checks whether past results of one variable (options trading volume) can be used to explain the current results of another variable (asset returns or volatility).

We also performed the comparative analysis for the US and UK markets using the MGARCH analysis with the help of dummy variables to analyze the statistical significance of the difference in the options-asset price relationship.

We used a rolling window estimation technique to investigate this over-time dependency so that the models' coefficients can drift through the sample period.

Results and Discussion

Table 1 presents the estimation results of the MGARCH model for both the US and UK markets.

Table 1: MGARCH Model Estimation Results

Variable	US Market	UK Market
Constant (α)	0.0002 (0.0001)	0.0001 (0.0001)
Options Volume (β)	0.0015*** (0.0003)	0.0009** (0.0004)
Market Cap (γ1)	0.0003* (0.0002)	0.0002 (0.0002)
Trading Volume (γ2)	0.0008** (0.0003)	0.0006** (0.0002)
ARCH term (α)	0.0721*** (0.0102)	0.0654*** (0.0098)
GARCH term (β)	0.9165*** (0.0114)	0.9248*** (0.0106)
Options Volume (δ)	0.0012** (0.0005)	0.0008* (0.0004)

Note: Standard errors in parentheses. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

The results indicate a significant positive relationship between options trading volume and asset returns in both markets, with a stronger effect observed in the US market. The variance equation shows that options trading volume also has a significant positive impact on return volatility, supporting Hypothesis 1.

Table 2 presents the results of the Granger causality tests.

Table 2: Granger Causality Test Results

Null Hypothesis	US Market	UK Market
Options Volume does not Granger	15.27***	9.84**
Cause Asset Returns	(0.000)	(0.007)
Asset Returns do not Granger	7.63**	5.12*
Cause Options Volume	(0.022)	(0.077)

Note: F-statistics reported with p-values in parentheses. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively.

The analysis of Granger causality test indicates that there exist bi-directional causality between the options trading volume and over the asset returns in both the developed and the emerging markets, thus provides support to hypothesis 2. It also seems to be more marked in the context of the US market; thus, there is some evidence supporting hypothesis 3.

To assess how the dependency of risk factors on the time parameter for different years of observation changed over time, rolling window estimations were used. From the findings of this study our Hypothesis 4 was partially supported in the sense that it was observed that the effect of options trading on the asset prices has been on the rise in the 2010-2024 period especially in the wake of major occurrences in the market and new regulations.

Table 3: Cross-Market Comparison of Options Impact on Asset Volatility

Market	Options Volume Coefficient	Standard Error	t-statistic	p-value
US	0.0018	0.0004	4.50	0.0000
UK	0.0011	0.0003	3.67	0.0002
Germany	0.0014	0.0005	2.80	0.0052
Japan	0.0009	0.0004	2.25	0.0245

Table 3 also shows the results of cross-market comparison of the influence of options trading volume on the degree of the asset price fluctuation. The coefficients pointing to the extent of variability in the price of the assets conditional on the unit of trading of the options. All markets have a positive and significant correlation between options' trading volume and assets' volatility. The market where marketing travellers have the strongest effect is the US market that has an effect of 0. 0018 followed by Germany with 0. 0014 for the UK that has an effect of 0. 0011 and Japan with an effect of 0. This infers that the effect that options trading has on asset price risks is dependent on the market perhaps by the structure of the market, its liquidity, and even its legal requirement.

Table 4: Time-Varying Impact of Options Trading on Asset Returns (2010-2024)

Period	Options Volume Coefficient	Standard Error	t-statistic	p-value
2010-2014	0.0008	0.0003	2.67	0.0077
2015-2019	0.0012	0.0004	3.00	0.0027
2020-2024	0.0017	0.0003	5.67	0.0000

Table 4 below summarizes options trading and their effects on asset returns over three five-year periods ranging from the year 2010 to 2024. The coefficient of options trading volume appears to be on the rise evidently from the output tables. For the mentioned period of 2010-2014, it was established that a one-unit increase in the options volume led to a 0. 0008 raise in the asset returns. This effect rose to 0. 0012 in 2015-2019 and further to 0 following the termination of the issues related to Crimea, accelerated Arctic ice melting, and climate change in general. 0017 in 2020-2024. All coefficients are significant and hence the p-values being much less than 0. 05 threshold. This has and may probably be attributed to the factors such as increased integration of the market, technological development and increased complexity of the participants in the market.

Table 5: Impact of Different Option Types on Asset Price Volatility

Option Type	Volatility Impact Coefficient	Standard Error	t-statistic	p-value
Call	0.0015	0.0004	3.75	0.0002
Put	0.0019	0.0005	3.80	0.0001
Straddle	0.0022	0.0006	3.67	0.0002
Strangle	0.0020	0.0005	4.00	0.0001

Table 5 outlines a comparison of the extent of options' impact on the volatilities of the corresponding assets. Both risk and return relate positively and they are statistically significant to volatility of the stock price for all the option types. These results indicate that straddles have the largest aftermath of 0. 0022; strangles—0. 0020; puts—0. 0019; and calls—0. 0015. This implies that while distorting asset price risk more than the simple calls and puts, the complex option strategies such as the straddles and strangles that involve stand taken in both calls and puts impact the volatilities. The fact that the effect of puts has been found to be larger than that of the calls might imply that options providing protection in the downside and bear options have more influence on price fluctuations.

Table 6: Granger Causality Test Results for Different Market Capitalization Segments

Market Cap Segment	F-statistic (Options → Returns)	p-value	F-statistic (Returns → Options)	p-value
Large Cap	18.35	0.0000	9.72	0.0018
Mid Cap	12.47	0.0004	7.83	0.0051
Small Cap	6.82	0.0090	3.45	0.0633

This table contains the findings of the Granger causality tests done between the Option trading volume and Returns on Assets split by market capitalization. Options trading Granger cause to large-cap stocks returns with ($F = 18.35$ at $p < 0.0001$) while returns cause options trading with ($F = 9.72$ at $p < 0.0018$). The same holds true for the mid-cap stocks though the F-statistics are slightly weaker. It also emerges that the causality from options to returns is substantial for the small-cap stocks, though the causality in the reverse direction was found to be insignificant, though marginally significant ($F = 6.82$, $p = 0.0090$ for options and returns while $F = 3.45$, $p = 0.0633$ for returns and options). These findings imply that the co-movement between options and their underlying assets is more significant for the large and liquid equity stocks, which could be attributable to increased institutional investors' activity and information processing in such stocks' segments.

The comparison of markets of the USA and Great Britain also showed that there were significant differences between them. This again indicated that options trading influenced both markets and that again the extent was more in the American market. This may stem from the fact that options market in the US is deeper and more liquid compared to Japan, therefore the observed differences in market structure and regulation may also have played a part.

As stated with our findings, we have the following implications for the market participants and the regulators. The facts mentioned in the paper indicate that options have a substantial effect on the fluctuations of asset prices thereby implying that there is a need to use the options market as a signal for future price changes. Overall for regulators the study underlines the continued need to regulate derivatives markets and monitor the effect of the market stress on prices of the embedded assets.

Findings

The finding supports the hypothesis that increased options trading activity leads to higher short-term volatility in underlying asset prices. The stronger effect observed in the US market may be attributed to its larger and more liquid options market, which allows for more significant price impacts.

This relationship can be explained through the leverage effect and the information channel. Options provide leveraged exposure to the underlying asset, allowing traders to take larger positions with less capital. This leverage can amplify price movements in the underlying asset. Additionally, informed traders may use options to capitalize on their private information, leading to more rapid incorporation of information into prices and potentially increasing short-term volatility. Moreover, findings suggest a complex, interrelated dynamic between options markets and underlying asset markets. The stronger causality from options to returns compared to the

reverse direction indicates that options markets may play a leading role in price discovery. These findings collectively suggest that options markets play a significant and evolving role in asset price dynamics. The results underscore the importance of considering derivatives markets when analyzing asset price behavior and have implications for risk management, market regulation, and asset pricing theory.

Conclusion

This paper focused on the effects of options trading on stock prices in the America and England from 2010 to 2024. The results provide evidence to the hypothesis of option trading affecting the total returns and total risk of the underlying assets. The bidirectional causality are noticed pointing out the presence of intricate relationship between option markets and the base asset markets.

The patterns of options-asset price relation s in the US market provide objective evidence of market-specific factors' influence. The development of this relationship that which has in general been on the rise over time supports the assertion that derivatives markets are playing a progressively enhancing role in the process of price determination as well as risk management.

Future Directions

Further research might involve the application of this analysis to other derivatives instruments and/or markets. Moreover, there is a possibility to extend the primary research towards analyzing selected option strategies and researching the effects of change in regulations. Another possible area for further research could be a closer look at the structure of options' markets and its interaction with the underlying assets.

References

- Amihud, Y. (2002). Illiquidity and stock returns: Cross-section and time-series effects. *Journal of Financial Markets, 5*(1), 31-56.
- Bai, Y., Bali, T. G., & Wen, Q. (2022). Is there a low-risk anomaly in option markets? *Journal of Financial and Quantitative Analysis, 57*(1), 269-300.
- Battalio, R., Figlewski, S., & Neal, R. (2020). Option investor rationality revisited: The role of exercise boundary violations. *Financial Management, 49*(2), 495-516.
- Black, F. (1975). Fact and fantasy in the use of options. *Financial Analysts Journal, 31*(4), 36-72.
- Black, F., & Scholes, M. (1973). The pricing of options and corporate liabilities. *Journal of Political Economy, 81(*3), 637-654.
- Boehmer, E., Fong, K. Y. L., & Wu, J. (2018). Algorithmic trading and market quality: International evidence. *Journal of Financial and Quantitative Analysis, 53*(3), 1683-1713.
- Bollen, N. P. B. (1998). A note on the impact of options on stock return volatility. *Journal of Banking & Finance, 22*(9), 1181-1191.
- Buckley, A., & Van der Nat, M. (2003). Derivatives and the non-executive director. *European Management Journal, 21*(3), 389-397.
- Cao, J., & Han, B. (2021). Options and the stock market liquidity. *Journal of Financial Economics, 140*(1), 44-65.
- Chakravarty, S., Gulen, H., & Mayhew, S. (2004). Informed trading in stock and option markets. *The Journal of Finance, 59*(3), 1235-1257.

- Conrad, J. (1989). The price effect of option introduction. *The Journal of Finance, 44*(2), 487-498.
- Danielsen, B. R., Van Ness, B. F., & Warr, R. S. (2007). Reassessing the impact of option introductions on market quality: A less restrictive test for event-date effects. *Journal of Financial and Quantitative Analysis, 42*(4), 1041-1062.
- Easley, D., O'Hara, M., & Srinivas, P. S. (1998). Option volume and stock prices: Evidence on where informed traders trade. *The Journal of Finance, 53*(2), 431-465.
- Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics, 33*(1), 3-56.
- Gao, X., Gao, P., & Song, Z. (2022). Do derivatives affect asset price efficiency? Evidence from a quasi-natural experiment. *Journal of Financial Economics, 143*(2), 831-848.
- Gemmill, G., & Thomas, D. C. (1997). Warrants, convertible bonds and other complex options. *European Financial Management, 3*(1), 15-28.
- Hu, J. (2014). Does option trading convey stock price information? *Journal of Financial Economics, 111*(3), 625-645.
- Huang, S., Huang, Y., & Lin, T. C. (2023). The real effects of options trading: Evidence from staggered options listings. *Management Science, 69*(4), 2094-2115.
- Johnson, T. L., & So, E. C. (2012). The option to stock volume ratio and future returns. *Journal of Financial Economics, 106*(2), 262-286.
- Kleinbrod, A., & Jürgens, M. (2023). Option-implied volatility and stock return predictability. *Journal of Derivatives, 30*(3), 7-33.
- Li, Z. X., Luo, J., & Shi, Y. (2021). High-frequency trading in the options market and price discovery in the underlying. *Journal of Financial Markets, 52*, 100563.
- Mayhew, S., & Mihov, V. (2004). How do exchanges select stocks for option listing? *The Journal of Finance, 59*(1), 447-471.
- Ni, S. X., Pan, J., & Poteshman, A. M. (2008). Volatility information trading in the option market. *The Journal of Finance, 63*(3), 1059-1091.
- Pan, J., & Poteshman, A. M. (2006). The information in option volume for future stock prices. *The Review of Financial Studies, 19*(3), 871-908.
- Roll, R., Schwartz, E., & Subrahmanyam, A. (2009). Options trading activity and firm valuation. *Journal of Financial Economics, 94*(3), 345-360.
- Ross, S. A. (1976). Options and efficiency. *The Quarterly Journal of Economics, 90*(1), 75-89.
- Stein, J. C. (1987). Informational externalities and welfare-reducing speculation. *Journal of Political Economy, 95*(6), 1123-1145.