Data & AI in Economics - 2024

Market reaction to Regulatory changes in UK between 2016-2020

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- In 2016, the Brexit negotiations began, culminating in the official withdrawal of the UK from the European Union in 2020. This research analyses the stock market reactions to regulatory announcements made by both the UK Government and the European Union during this pivotal period. Using descriptive statistical analysis and various statistical techniques, we explore how different sectors, including Banking, Financial Services, Insurance, and Real Estate, responded to these regulatory events.
- Regulatory changes have long been a subject of study, with extensive research being conducted on their impact on market behaviour. However, following the financial crisis of 2008, the scrutiny on such changes intensified to prevent similar disruptions. This analysis focuses on the specific period from 2016 to 2020, offering insights into how Brexit-related regulatory announcements affected stock market performance in key sectors.

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1. **Study**: Kawas and Dockery [1] use an event study to analyze the impact of regulatory announcements on UK financial institutions' stock price volatility.

- **Sectors Analyzed**: Banks, insurance, real estate, and other sectors.
- **Focus**: Investigate how volatility and stock returns change with regulatory announcements and whether the market anticipates or reacts.
- **Period Covered**: 2000-2014 (excludes Brexit period).
- Findings:
  - Mixed market reactions to regulatory announcements.
  - Positive reactions to announcements from the FSA and UK Government.
  - Limited impact from EU, PRA, IC, and ICB regulatory measures.

2. **Study**: Fratianni and Marchionne [2] analyze the stock market response to bank bailout announcements.

- **Focus**: Investigates market reactions to government funding for banks during financial stress or to prevent bank failure.
- Findings:
  - Announcements targeting the entire banking system led to **positive cumulative abnormal returns**.
  - Announcements aimed at specific banks resulted in **negative cumulative abnormal returns**.
  - Consistent with the hypothesis that banks were reluctant to seek public assistance.
  - Suggests large public commitments were perceived as **either not credible or inadequate** in addressing the underlying financial difficulties.

3. **Study**: Xie, Wang, and Huynh [3] examine the impact of social trust on stock market reactions to government lockdown and reopening announcements during COVID-19 across 44 countries.

- Findings:
  - Lockdown announcements led to negative stock market reactions.
  - Reopening announcements triggered minimal market responses.
  - Higher social trust correlated with:
    - More positive reactions to lockdowns.
    - More negative reactions to reopening.
  - Results show **significant negative influence** of lockdown announcements on most stock markets.
  - Stock market reactions to reopening announcements were **relatively marginal** and possibly biased negatively.
  - **Generalised social trust** positively affected stock market responses to lockdowns and negatively affected responses to reopening.

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4. **Study**: Lobão and Santos [4] investigate semi-strong market efficiency in seven European stock markets using four Brexit-related announcements as exogenous shocks.

- Findings:
  - Only the Brexit referendum result caused significant negative cumulative abnormal returns.
  - These negative returns disappeared within five trading sessions, except in Ireland.
  - **Increased trading activity** was observed around the referendum, though not statistically significant.
  - Results support the semi-strong form of market efficiency.

Data Preparation

- Data Collection:
  - Gathered FTSE 350 data for Banks, Insurance, and Financial Services.
  - Data sourced from London Stock Exchange, Yahoo Finance UK, www.Investing.com, Financial Conduct Authority.

- Regulatory Announcements:
  - Collected announcements from the **UK Government** and **European Union** for the period **2016-2020**.
  - **Cross-checked** each regulatory announcement to confirm it occurred.
  - Utilised **ChatGPT** with extensive **prompt engineering** to source the announcements.
  - **36 regulatory announcements** were finalised after narrowing down results.

Data Preparation

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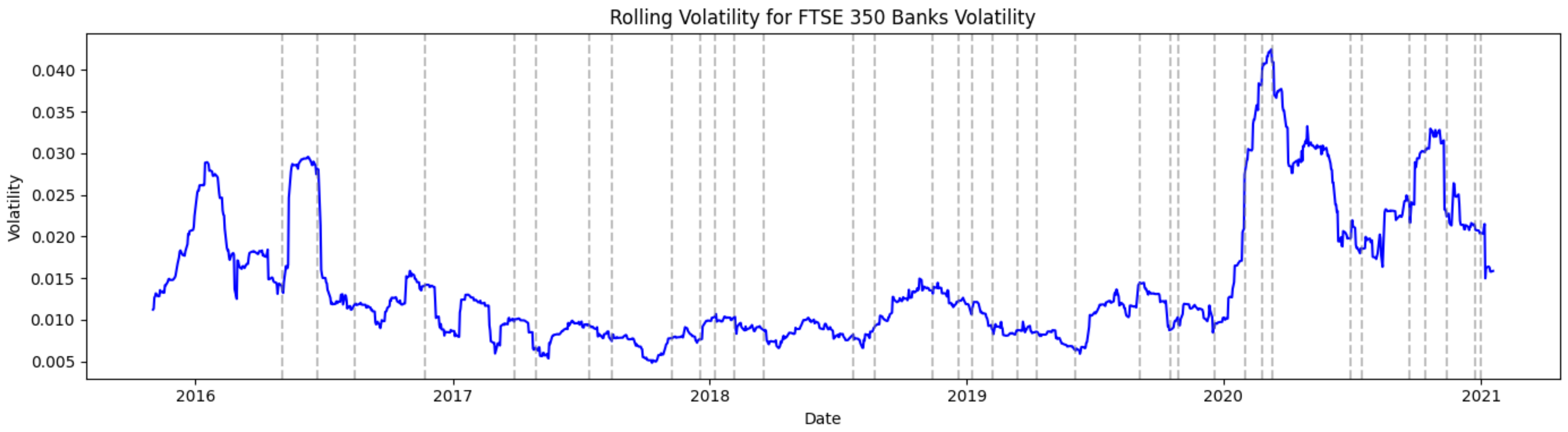
- Failed Attempts:
  - Tried gathering announcements from the **Financial Conduct Authority (FCA)** and **Prudential Regulation Authority (PRA)** for the same period, but no significant announcements were found during **Brexit (2016-2020)**.
- Challenges:
  - Most time-consuming step: **cross-checking** announcements through **Google** searches to ensure accuracy.
- Next Steps:
  - Use **Python** to perform detailed **descriptive analysis** and various **statistical tests**.
  - Focus analysis on the **Returns** column from the market data to assess the market reaction to regulatory announcements during the Brexit period.

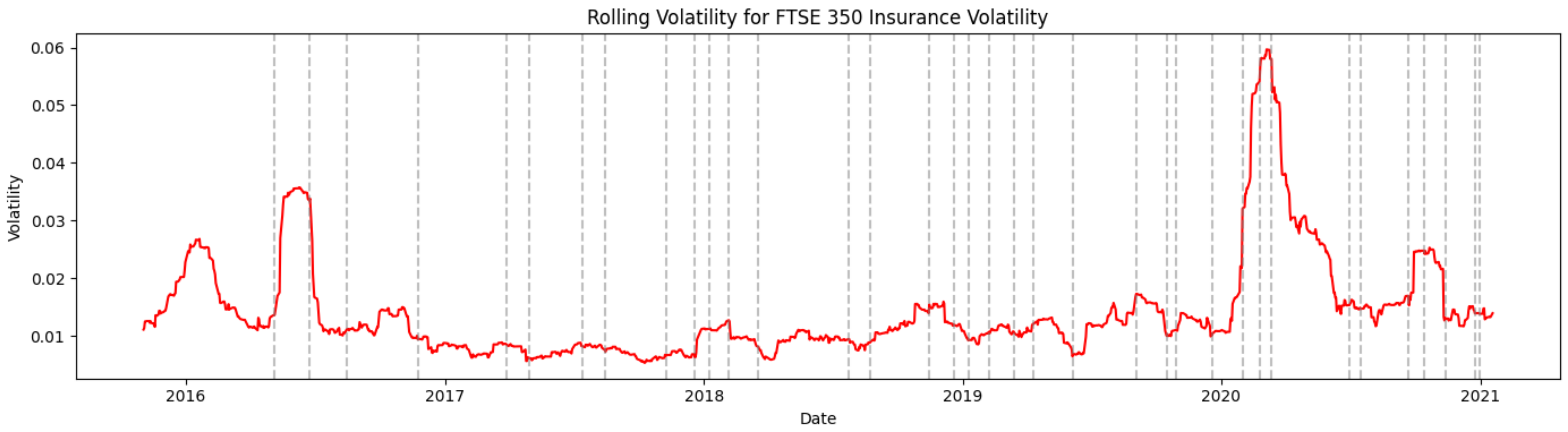
Regulation Data

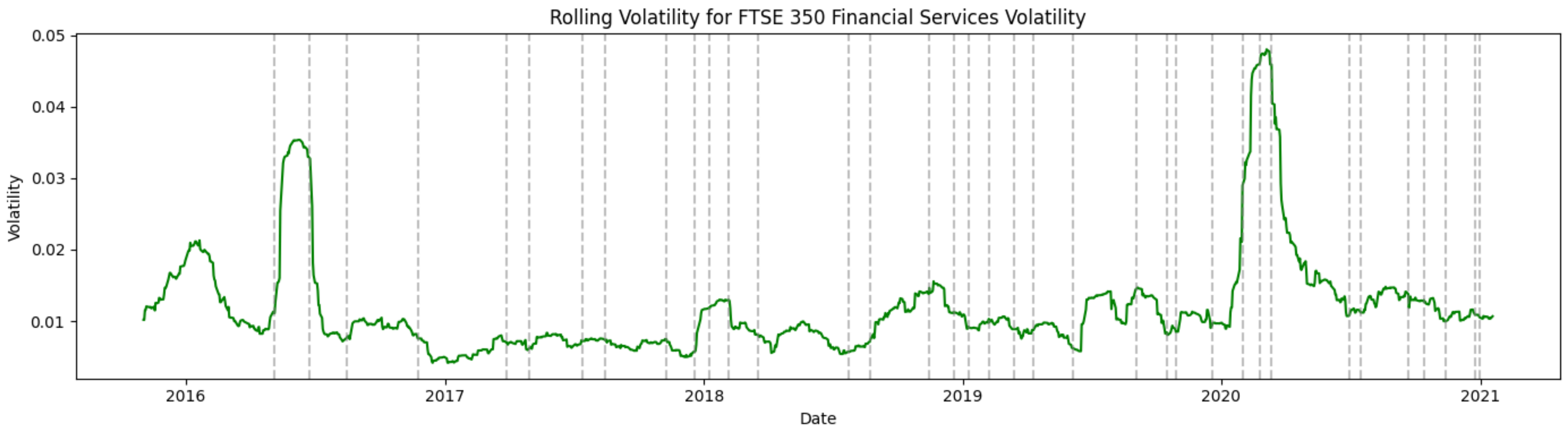
Date	Event/Announcement	Organization
2016-06-23	UK votes to leave the European Union (Brexit Referendum). The referendum result leads to significant implications for the banking sector, particularly concerning regulatory alignment, passporting rights, and access to the European single market. Banks begin assessing the potential impact on their operations and regulatory compliance.	UK Government
2018-03-19	UK and EU reach agreement on Brexit transition period. The transition period is set from March 29, 2019, to December 31, 2020, during which EU law continues to apply in the UK. This provides temporary regulatory certainty for banks operating across UK-EU borders.	UK Government and European Union
2020-01-31	The United Kingdom formally exits the European Union, entering a transition period. The UK leaves the EU, beginning an 11-month transition period during which EU laws and regulations continue to apply. This has significant implications for banking regulations and future UK-EU financial relations.	UK Government and European Union
2020-06-30	Deadline to extend the Brexit transition period passes without extension. The UK Government confirms it will not seek an extension, meaning the transition period will end on December 31, 2020. Banks must prepare for regulatory changes and potential disruptions in UK-EU financial services.	UK Government
2020-12-31	Brexit transition period ends. EU law ceases to apply in the UK, and new regulatory frameworks come into effect. Banks must now comply with UK-specific regulations and any applicable EU regulations for their EU operations, significantly impacting cross-border financial services.	UK Government and European Union

Price Trend Plots

Price Trend Plots







Regulatory Announcement Impact - FTSE 350 Banks

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	Event Date	Expected Return	Mean Abnormal Return	T-Statistic	P-Value
0	2016-08-15	0.009367	-0.009000	-3.635972	0.006627
1	2016-11-23	0.004429	-0.006741	-3.134240	0.016512
2	2017-08-15	-0.005750	0.005350	2.424316	0.041569
3	2017-11-08	-0.003043	0.002680	2.463395	0.043250
4	2019-09-04	0.001117	0.009133	2.514139	0.040153
5	2019-10-17	0.007537	-0.005052	-2.730851	0.034147
6	2019-12-19	0.008075	-0.009375	-3.481307	0.025322

Regulatory Announcement Impact - FTSE 350 Insurance

	Event Date	Expected Return	Mean Abnormal Return	T-Statistic	P-Value
0	2016-05-04	-0.008733	0.005896	2.659405	0.032495
1	2016-08-15	0.006250	-0.010017	-3.254216	0.011627
2	2019-09-04	-0.002117	0.015917	4.218279	0.003945
3	2019-12-19	0.009012	-0.008513	-5.163360	0.006683
4	2020-07-16	0.005713	-0.012712	-3.087388	0.021459
5	2020-11-13	0.027100	-0.021271	-6.113216	0.000874

Regulatory Announcement Impact - FTSE 350 Financial Service

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	Event Date	Expected Return	Mean Abnormal Return	T-Statistic	P-Value
0	2016-08-15	0.007300	-0.007422	-3.286993	0.011072
1	2016-11-23	0.003829	-0.006916	-3.702005	0.007635
2	2017-03-29	-0.003186	0.006473	2.830303	0.025395
3	2017-07-13	0.000425	0.004661	2.935578	0.026097
4	2019-12-19	0.007400	-0.003200	-2.777887	0.049926
5	2020-11-13	0.013625	-0.014982	-5.136983	0.002142

Methodology - Ordinary Least Squares (OLS)

OLS (Ordinary Least Squares) is a regression method used to estimate the relationship between a dependent and one or more independent variables by minimising the sum of squared differences between observed and predicted values.

Key Assumptions:

- **Linearity**: The relationship is linear.
- **Constant Variance**: The variance of errors is constant (Homoscedasticity).
- **Independence**: Observations are independent.
- **No Multicollinearity**: Independent variables are not highly correlated.

Key Components:

- **Minimises Squared Errors**: Finds the best-fit line by minimising squared residuals.
- **Regression Coefficients**: Estimates the impact of each independent variable.
- **Residuals**: The differences between observed and predicted values.

Why Use OLS?

- **Simple & Interpretable**: Easy to apply and interpret for linear relationships.
- **Quick Estimation**: Provides fast, efficient results.
- **Effective for Stable Data**: Best suited for data with constant variance, without volatility clustering.

Methodology - GARCH

GARCH (Generalized Autoregressive Conditional Heteroskedasticity) is an extension of the ARCH model developed by Tim Bollerslev in 1986. It builds on ARCH by allowing both past residuals and past volatility to influence current volatility. GARCH is widely used in financial time-series analysis to model persistent volatility over time.

Key Assumptions of GARCH:

- Volatility is time-varying and exhibits persistence (i.e., periods of high volatility tend to be followed by more high volatility).
- The current period's volatility depends not only on past squared residuals (as in ARCH) but also on the previous period's volatility itself.

Key Components of GARCH:

- **Conditional Heteroskedasticity**: Variance of the errors (shocks) changes over time.
- **Lagged Squared Errors**: Like ARCH, GARCH assumes volatility depends on previous periods' squared residuals.
- **Lagged Volatility Terms**: GARCH incorporates previous volatility, allowing it to better capture the persistence of market volatility.

Why Use GARCH in Financial Market Analysis?

- **Volatility Persistence**: GARCH is ideal for modelling financial data where volatility persists over time.
- **Better Forecasting**: By considering both past residuals and volatility, GARCH provides more accurate forecasts for future volatility.
- **Long-Term Effects**: GARCH can capture how market shocks, such as regulatory announcements, cause volatility that lasts beyond just one period, making it valuable for understanding market behavior during extended periods of uncertainty.

EGARCH (Exponential Generalized Autoregressive Conditional Heteroskedasticity) is an extension of the GARCH model developed by Daniel Nelson in 1991. Unlike GARCH, EGARCH models volatility logarithmically, which allows it to capture asymmetric effects in financial data, such as the leverage effect, where negative shocks increase volatility more than positive shocks.

Key Assumptions of EGARCH:

- Volatility is time-varying and responds asymmetrically to shocks (i.e., negative news has a larger impact than positive news).
- Unlike GARCH, EGARCH does not require the variance to be non-negative due to its logarithmic structure.

Key Components of EGARCH:

- **Logarithmic Volatility**: Volatility is modelled as a log function, ensuring it is always positive without restrictions.
- **Asymmetry in Volatility Response**: EGARCH captures the "leverage effect," where negative shocks lead to greater volatility than positive ones.
- **Lagged Squared Errors**: Like GARCH, EGARCH incorporates past residuals, but the effects are scaled logarithmically.
- **Lagged Volatility Terms**: EGARCH includes past volatility, allowing it to capture long-term volatility patterns.

Why Use EGARCH in Financial Market Analysis?

- **Asymmetric Volatility**: EGARCH is particularly useful for markets where bad news disproportionately increases volatility compared to good news.
- **Captures Leverage Effect**: EGARCH models the stronger impact of negative shocks on volatility, which is common in financial markets.
- **More Flexibility**: The logarithmic structure of EGARCH allows for more flexible modelling of volatility and better handling of extreme market movements, such as those caused by regulatory changes or major economic events.

Methodology - GJR-GARCH

GJR-GARCH (Glosten-Jagannathan-Runkle Generalized Autoregressive Conditional Heteroskedasticity) is an extension of the traditional GARCH model, developed by Glosten, Jagannathan, and Runkle in 1993. It introduces an additional term to capture the asymmetric effects of positive and negative shocks on volatility, commonly observed in financial markets.

Key Assumptions of GJR-GARCH:

- **Volatility is time-varying** and exhibits clustering, where periods of high volatility are followed by more volatility, and periods of low volatility are followed by stability.
- The model captures **asymmetry** in the response of volatility to positive and negative shocks, reflecting that negative news tends to cause greater increases in volatility than positive news.

Key Components of GJR-GARCH:

- **Asymmetry in Volatility Response:** The model adds an extra term to account for the fact that negative shocks (bad news) tend to have a greater impact on volatility than positive shocks (good news). This effect is known as the "leverage effect."
- **Volatility Clustering:** Like GARCH, GJR-GARCH assumes that volatility clusters, meaning that large changes in returns are followed by more large changes.
- **Lagged Squared Errors:** GJR-GARCH includes past residuals (errors) to account for the impact of previous periods' shocks on current volatility, but adds an asymmetric term for negative residuals.
- **Lagged Volatility Terms:** Similar to GARCH, it incorporates past volatility to capture the persistence of volatility over time, ensuring the model reflects long-term market behavior.

Why Use GJR-GARCH in Financial Market Analysis?

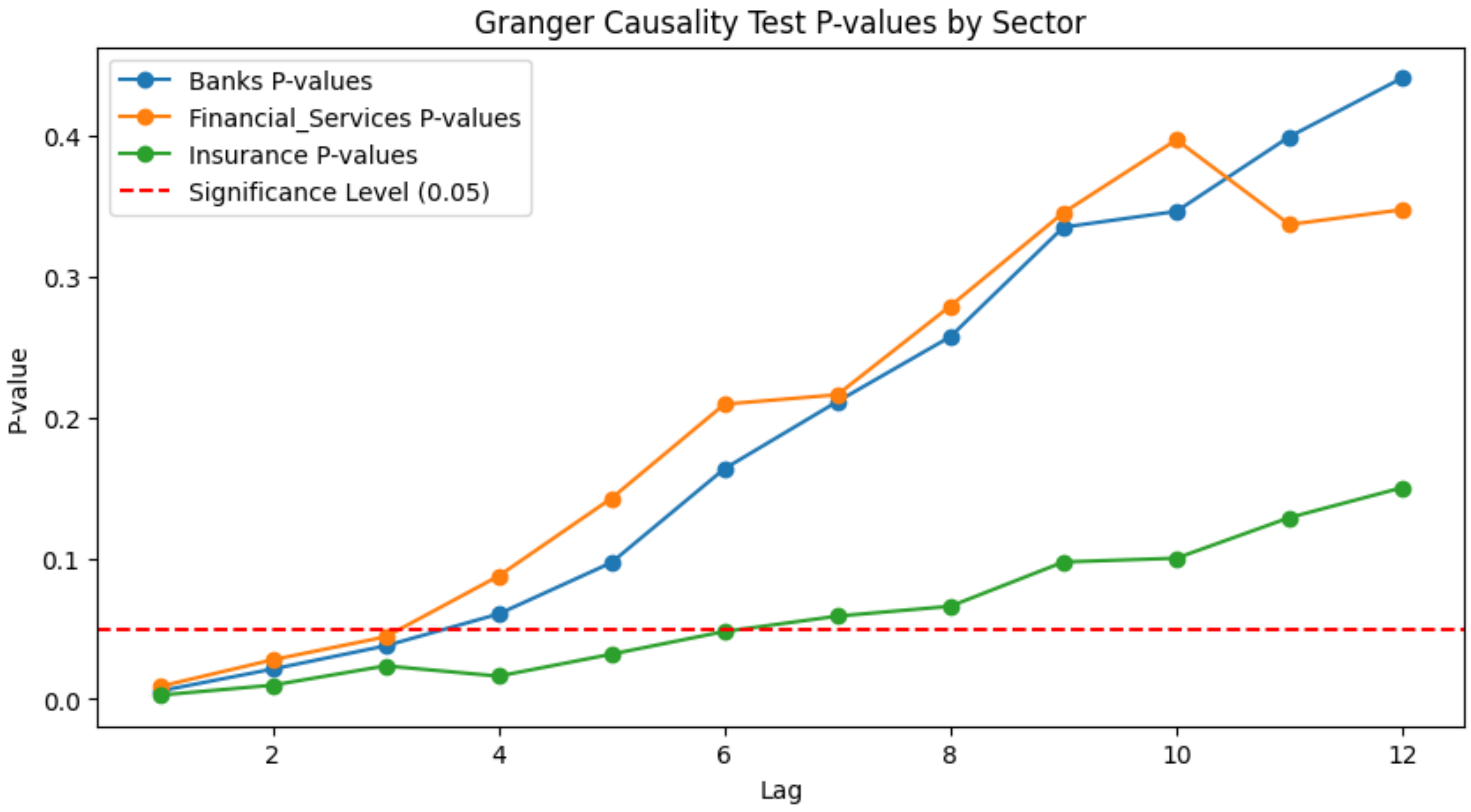
- **Captures Asymmetric Effects:** GJR-GARCH is especially useful when markets react more strongly to negative news than to positive news, a common feature in financial markets. It effectively models the "leverage effect" seen in stock returns, where downturns lead to sharp volatility increases.
- **Improved Risk Modelling:** By capturing the heightened response to bad news, GJR-GARCH provides a more accurate measure of market risk, which is crucial for portfolio management, risk assessment, and regulatory policy analysis.
- **Volatility Forecasting:** The model is widely used to forecast volatility in financial markets, where understanding the future path of volatility is key for pricing derivatives, risk management, and trading strategies.

Methodology - Granger Causality

Granger Causality: Regulatory announcements Granger-cause stock returns in the **Banks, Financial Services**, and **Insurance** sectors, particularly at shorter lags (1 to 3).

- **Immediate Impact**: The impact is strongest at **lag 1** for all sectors, indicating that regulatory announcements have an **immediate and significant effect** on stock returns.
- **Longer-term Effects**: The **Insurance** sector shows longer-term effects (up to **lag 5**), suggesting that regulatory announcements have a more **persistent impact** on insurance stocks compared to banks and financial services.
- **Sensitivity of Returns**: **Banks** and **Financial Services** exhibit strong Granger causality at **lag 1**, indicating that their returns are highly sensitive to regulatory news in the short term. However, the effects diminish beyond **lag 3**.
- **Predictive Power**: These findings suggest that regulatory announcements can **predict changes in stock returns**, with the most significant effects occurring **immediately after the announcement**, particularly for the **insurance sector**.

Results - Granger Causality



Conclusion

Model	Sector	Key Findings	Conclusion
OLS Model	Insurance	Regulatory_Announcements Coefficient (-0.2435, p = 0.390): No statistically significant effect.	No significant impact of regulatory announcements on insurance returns detected by the OLS model.
	Banks	Regulatory_Announcements Coefficient (-0.2925, p = 0.296): No statistically significant effect.	No significant impact of regulatory announcements on banking returns detected by the OLS model.
	Financial Services	Regulatory_Announcements Coefficient (-0.2700, p = 0.250): No statistically significant effect.	No significant impact of regulatory announcements on financial services returns detected by the OLS model.
GARCH Model	Insurance	Alpha[1] (0.0792, p = 0.012), Beta[1] (0.9186, p < 0.001): Persistent volatility post-announcements.	Regulatory announcements increase volatility, and the effect is long-lasting.
	Banks	Alpha[1] (0.2019, p < 0.001), Beta[1] (0.7527, p < 0.001): Volatility increases but less persistent.	Regulatory announcements increase volatility, but banks recover quicker compared to other sectors.
	Financial Services	Alpha[1] (0.1531, p < 0.001), Beta[1] (0.8234, p < 0.001): Increased volatility, lower persistence.	Volatility increases after regulatory announcements, but the persistence is lower than in the insurance sector.
EGARCH Model	Insurance	Alpha[1] (0.1884, p < 0.001): Asymmetric response, negative news causes greater volatility.	Negative news (e.g., regulatory announcements) causes a strong increase in volatility in the insurance sector.
	Banks	Alpha[1] (0.3474, p < 0.001): Strong asymmetric response to negative news.	Regulatory announcements lead to a strong rise in volatility, especially after negative news.
	Financial Services	Alpha[1] (0.3017, p < 0.001): Negative news drives higher volatility.	Regulatory announcements lead to higher volatility in the financial services sector, particularly after negative announcements.
GJR-GARCH Model	Insurance	Gamma[1] (0.0662, p = 0.078): Weaker asymmetric effect of negative news on volatility.	Negative regulatory announcements increase volatility, but the impact is slightly weaker than in other models.
	Banks	Gamma[1] (0.1578, p = 0.003): Significant asymmetric effect, negative news drives volatility.	Negative regulatory announcements cause significant increases in volatility.
	Financial Services	Gamma[1] (0.1578, p = 0.003): Significant asymmetry, with negative news driving volatility.	Regulatory announcements, particularly negative ones, increase volatility significantly in financial services.
Granger Causality	Insurance	Lag 1 (F = 8.8904, p = 0.0029): Regulatory announcements Granger-cause insurance returns.	Regulatory announcements Granger-cause insurance returns, with the strongest effect at lag 1.
	Banks	Lag 1 (F = 7.6295, p = 0.0058): Regulatory announcements Granger-cause bank returns.	Regulatory announcements Granger-cause bank returns, with the strongest effect at lag 1.
	Financial Services	Lag 1 (F = 6.8275, p = 0.0091): Regulatory announcements Granger-cause financial services returns.	Regulatory announcements Granger-cause financial services returns, with the strongest effect at lag 1.

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Model	Conclusion
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	No significant impact of regulatory announcements on financial services returns detected by the OLS model.
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	Regulatory announcements increase volatility, but banks recover quicker compared to other sectors.
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EGARCH Model	Negative news (e.g., regulatory announcements) causes a strong increase in volatility in the insurance sector.
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	Regulatory announcements Granger-cause financial services returns, with the strongest effect at lag 1.

Conclusion

1. **Market Inefficiency**: Financial markets did not efficiently price in regulatory changes, showing a lag in investor response.
2. **Mixed Market Reactions**:
   - Banks: Significant volatility, especially with stricter regulations, but faster recovery.
   - Insurance: Persistent volatility, particularly from increased compliance costs and negative news.
   - Financial Services: Volatility similar to insurance but less persistent.
3. **Impact of Regulatory Changes**:
   - Regulatory announcements increase market volatility, especially in response to negative shocks.
   - Negative news has a greater impact than positive announcements.
4. **Volatility Models (GARCH, EGARCH, GJR-GARCH):**
   - Show significant volatility increases after regulatory news, with asymmetric effects (negative shocks cause more volatility).
5. **Granger Causality:**
   - Regulatory announcements Granger-cause returns across sectors, with the strongest immediate impact at lag 1.
6. **Key Takeaways:**
   - Insurance and Financial Services are highly sensitive to regulatory changes.
   - We see significant evidence of Regulations affecting the markets from outputs.
   - Banks recover more quickly from regulatory shocks.
   - Negative regulatory news drives larger market reactions than positive news.

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Just some of the few…

Thank You. Questions?