COMPSS 224B - Final Project

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This is a story about how a major policy announcement, Italy's increased defense spending in April 2025, momentarily disrupted European markets and media sentiment, but did not result in lasting political risk. By combining sovereign bond yield spreads, news sentiment from GDELT, and regional market indicators like the Euro Stoxx 50 index, this project builds a machine learning-based plausibility probe to detect shifts in perceived risk. The results show a brief, post-announcement spike in risk characteristics, as identified through clustering of economic and sentiment variables. However, the system stabilized quickly, suggesting the event triggered concern but not long-term instability. The analysis offers a framework for clients to monitor short-term political risk shocks and their resolution using automated data pipelines.

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1 Background

In April 2025, the Italian government announced a significant increase in defense spending, marking a sharp departure from its traditionally cautious fiscal stance. While the move was framed as a response to shifting geopolitical dynamics and NATO obligations, the announcement raised immediate concerns about sovereign debt sustainability, market stability, and political cohesion within the Eurozone.

Italy has long faced scrutiny due to its high debt-to-GDP ratio—reaching over 140% in 2024—and persistent structural economic weaknesses. Policy decisions that increase fiscal pressure, such as expanded military budgets, can heighten investor anxiety and contribute to market volatility. However, early-warning systems that integrate real-time data on political sentiment, market responses, and bond spreads are rarely accessible to private clients or smaller institutional investors.

As an illustrative case, Italian 10-year bond yields rose from 4.87% to 5.17% in the week following the April 4 announcement. Meanwhile, the Italy–Eurozone average yield spread peaked above 0.75 percentage points, its highest point in months. On the media side, GDELT sentiment analysis revealed a short-term dip in Goldstein scores and Average Tone on Italian-related news, indicating more negative event framing during the same period.

Despite these signals, many clients—such as political risk insurers, multinational asset managers, or regional banks—lack the infrastructure to integrate bond data, media sentiment, and machine learning-based pattern detection into their decision-making. This project aims to demonstrate how a lightweight and modular pipeline can fill that gap and help users monitor short-term political risk dynamics with higher frequency and sensitivity.

2 Exploratory Data Analysis

2.1 Bond Yields and Spread

I begin my analysis by exploring the behavior of sovereign bond yields across Eurozone countries, focusing on Italy's response to the April 4, 2025 defense spending announcement. Figure 1 displays the 10-year government bond yields of eight major Eurozone countries. While yields in most countries continued to decline throughout the period, Italy exhibited a temporary upward movement immediately following the policy announcement, indicating potential investor concerns.

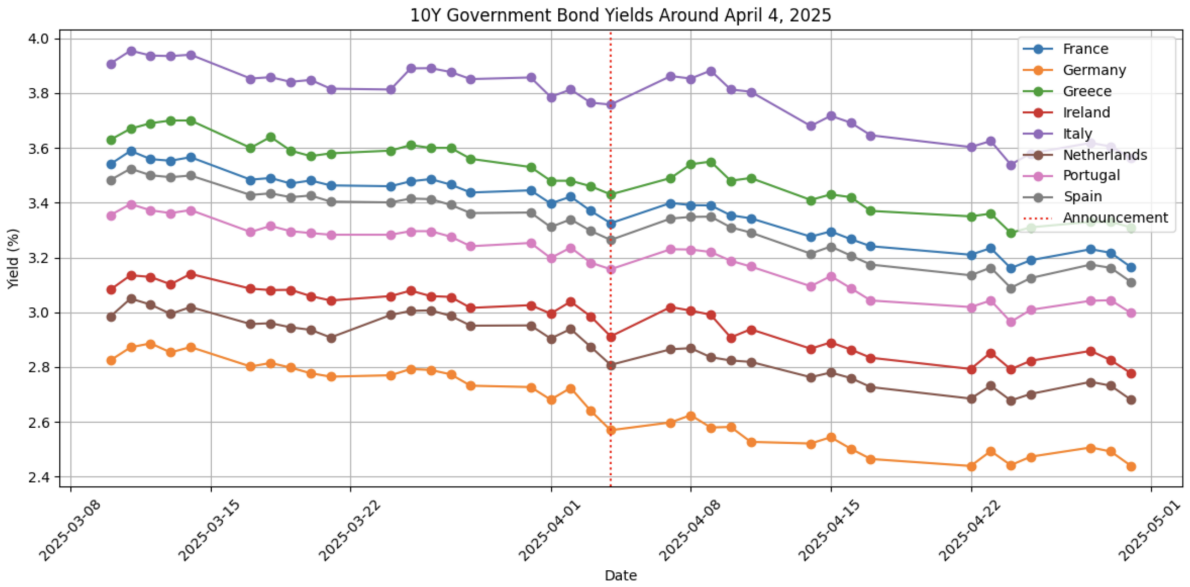

Figure 1: 10Y Government Bond Yields Around April 4, 2025

To better isolate Italy's relative movement, I plot the spread between Italy's 10Y yield and the Eurozone average (excluding Italy) in Figure 2. From January to late March 2025, the spread

remained mostly stable, fluctuating between 0.68% and 0.75%. However, shortly after the announcement, the spread peaked at 0.825%, suggesting a transient shock in Italy's perceived credit risk.

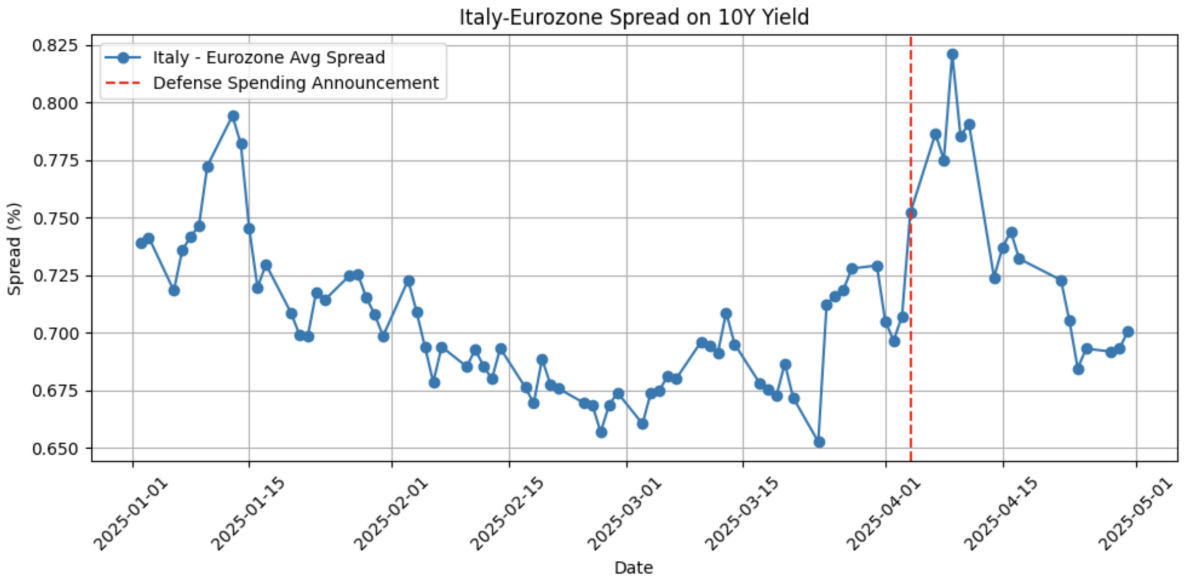

Figure 2: Italy-Eurozone Spread on 10Y Yield

The spike in the spread reflects a temporary market response, potentially driven by uncertainty over debt sustainability, political consequences, or macroeconomic impacts of the increased defense budget. Nevertheless, the spread narrowed back within two weeks, indicating that the perceived risk was not persistent.

2.2 News Sentiment Signals from GDELT

To complement the bond market perspective, I analyze daily sentiment toward Italy using GDELT's global news event database. Figure 3 plots the average **Goldstein Scale** and **Average Tone** of Italy-related news reports between March and April 2025.

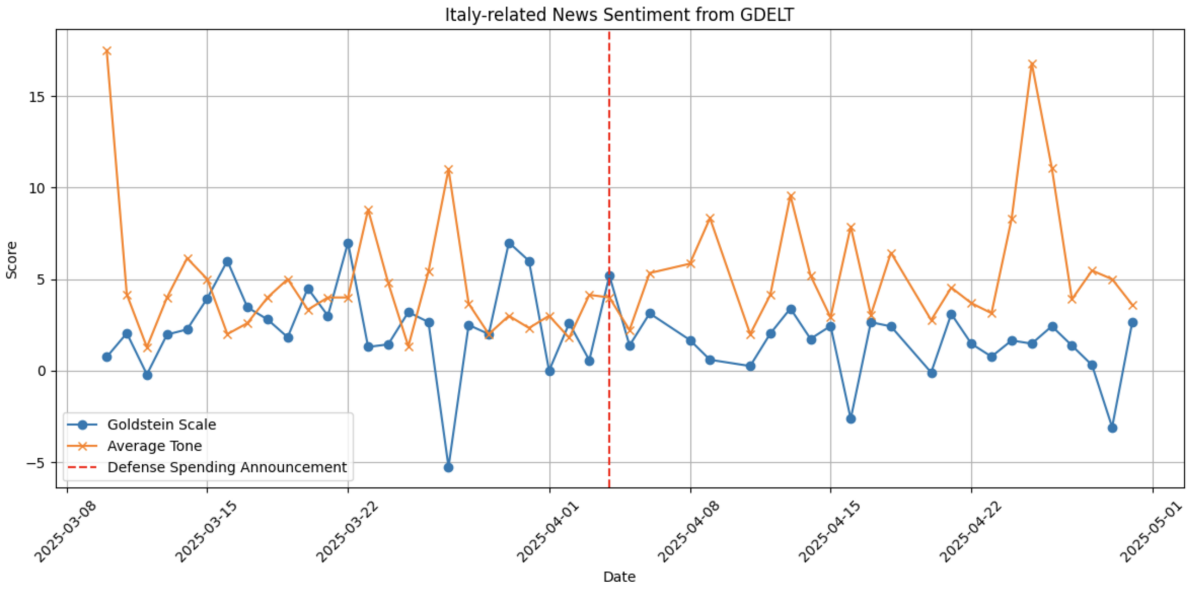

Figure 3: Italy-related News Sentiment from GDELT

In the days immediately following the April 4 announcement, both sentiment indicators reflect a shift in media tone. The Goldstein Scale, which quantifies the impact or conflict intensity of reported events, shows increased variance and a mild decline—indicating heightened perceived tension or disruption. Meanwhile, the Average Tone fluctuates but remains relatively elevated, suggesting a mixture of critical and neutral-positive framing in news coverage.

While these changes are not dramatic, they align with the observed spike in bond spreads and support the hypothesis that the defense announcement triggered a short-lived uptick in political risk perceptions. Importantly, the sentiment indicators stabilized shortly after, reinforcing the conclusion that the event had a temporary effect on market and media behavior.

2.3 Regional Market Response

To capture broader regional investor sentiment, I track the performance of the **Euro Stoxx 50 Index**, a benchmark index representing 50 large-cap companies in the Eurozone. Figure 4 illustrates the index's movement from March to the end of April 2025.

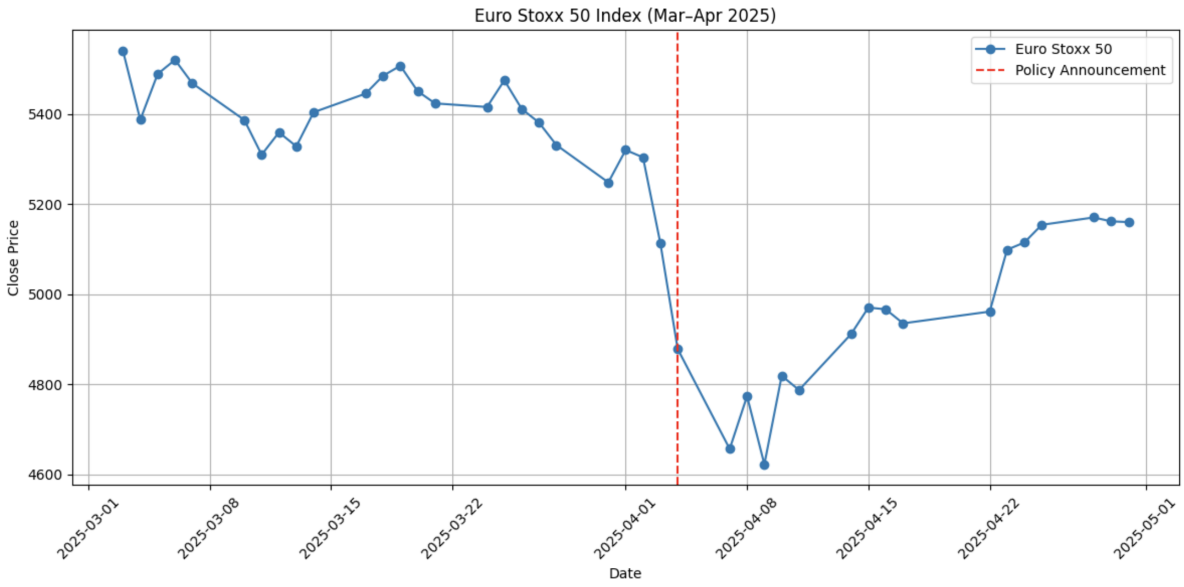

Figure 4: Euro Stoxx 50 Index (Mar–Apr 2025)

The index experienced a sharp drop immediately after the April 4 announcement, declining by over 400 points (approximately 8%) within a week. This broad-based decline reflects a temporary market shock, likely due to investor uncertainty surrounding increased government expenditure and its potential macroeconomic implications.

However, the index began to recover after April 10 and regained most of the losses by the end of the month. This rebound supports the earlier bond spread and sentiment findings: the perceived political or fiscal risk was short-term and did not fundamentally disrupt investor confidence in the Eurozone.

3 Model Analysis

3.1 Unsupervised Study

To quantify political risk, I applied an unsupervised machine learning method—KMeans clustering—using five core features: Italy's 10-year bond yield, the spread between Italy and the Eurozone average yield, GDELT's Goldstein Scale (conflict intensity), average news sentiment tone, and the Euro Stoxx 50 index.

All features were standardized using StandardScaler, and KMeans was configured with two clusters to represent relatively high-risk and low-risk periods. To visualize the results, I performed a PCA projection of the high-dimensional features into two components, and plotted both the clustering result and its time trend.

Table 1: Cluster Feature Means from KMeans Clustering

Cluster	Italy	Italy_Euro_Spread	GoldsteinScale	AvgTone
0	3.737	0.755	1.491	4.766
1	3.799	0.696	1.597	5.273

As shown in Table 1, Cluster 0 displays lower sentiment tone, higher bond spread, and slightly lower political stability (Goldstein scale), which collectively indicate a relatively higher risk environment. Conversely, Cluster 1 reflects lower perceived risk conditions.

By tracking the shift in cluster membership over time, this model can function as a real-time political risk index for investors and analysts.

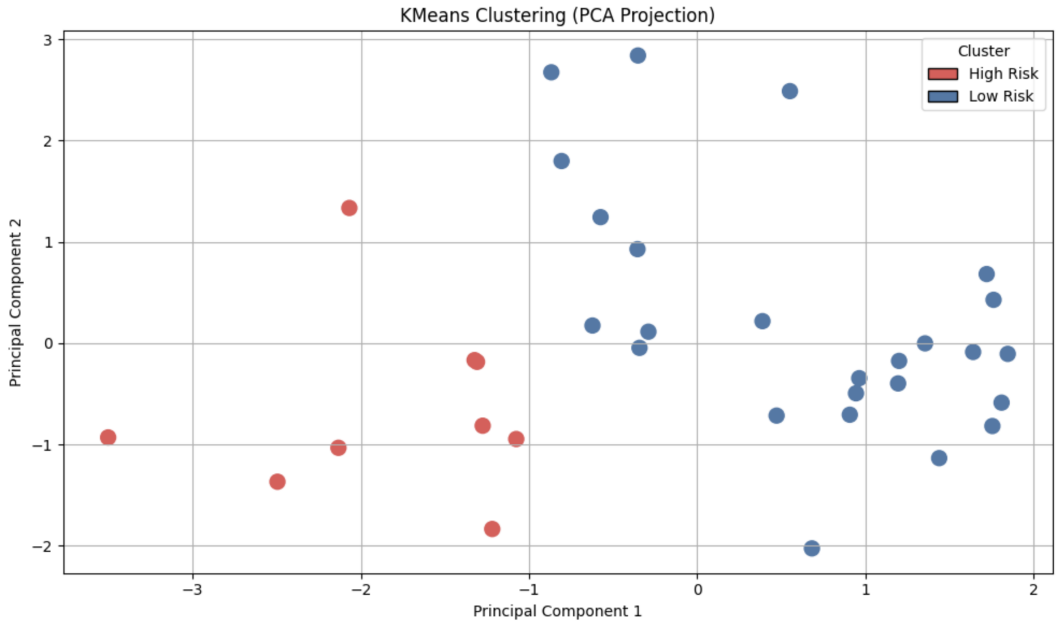

Figure 5: PCA Projection of KMeans Clustering with Political Risk Features

Figure 5 visualizes the clustering result using a PCA (Principal Component Analysis) projection. Each point represents a daily observation between March and April 2025, based on standardized values of Italy's 10-year bond yield, the yield spread over the Eurozone average,

news sentiment scores from GDELT, and the Euro Stoxx 50 index.

The two-dimensional projection reveals a clear separation between two clusters. The red points (labeled as "High Risk") tend to occupy a distinct region of the PCA space, indicating patterns of higher bond spreads, lower sentiment, and weaker market performance. In contrast, the blue points ("Low Risk") cluster together on the other side, characterized by relatively stable financial and sentiment indicators.

This figure provides an intuitive, dimensionality-reduced representation of the model's risk assessment, supporting the feasibility of using unsupervised learning to monitor short-term shifts in political risk conditions.

3.2 Time Series Analysis

Cluster Dynamics Over Time

Figure 6: Time Series Cluster Assignment of Political Risk Index (Mar–Apr 2025)

To track political risk evolution over time, I visualize each day's cluster label based on the unsupervised index (Figure 6). The red vertical line marks April 4, 2025—the date of Italy's defense spending policy announcement.

Before April 4, most observations fall into the Low Risk cluster. Immediately following the policy announcement, there is a shift into the High Risk cluster, marked by the combination of widening bond spreads, deteriorating sentiment (lower Goldstein Scores and Average Tone), and falling equity index levels. This spike persists for several trading days before the cluster stabilizes again, reflecting a short-lived but detectable impact of the policy event.

This pattern supports the model's ability to capture meaningful, real-time reactions to political developments, offering decision-makers a timely, data-driven risk alert.

4 Risk Analysis

4.1 Hypotheses

H_1:

1. CDS spreads and government bond yields increase significantly within one week of defense budget announcements, indicating heightened perceived credit risk.

2. The BTP-Bund spread widens significantly, signaling greater investor concern toward Italy compared to more stable Eurozone economies.

3. Public sentiment becomes more negative and public opinion becomes more polarized, particularly around concerns about social spending trade-offs and institutional credibility.

The results provide clear support for H_1**(2)** and H_1**(3)**. Following the April 4, 2025 defense spending announcement, the **Italy–Eurozone yield spread** widened noticeably (Figure 2), suggesting elevated investor concern toward Italy relative to its Eurozone peers.

Sentiment analysis from GDELT also shows a dip in tone and Goldstein scores post-announcement (Figure 3), aligning with increased political tension and public unease. These shifts are reflected in my clustering model, which classifies multiple post-announcement days as High Risk—marked by wider spreads, more negative sentiment, and weaker equity performance.

Together, these results highlight the short-term political and financial impact of defense policy shocks, validating the use of market and media data to monitor sovereign risk.

4.2 Social Science Assumptions

This analysis assumes that financial markets and news media respond promptly and meaningfully to political events such as defense spending announcements. It also assumes that bond yield spreads and sentiment indicators reflect collective perceptions of sovereign risk. These are plausible in the short term, especially in highly monitored economies like Italy. However, they may be affected by unrelated macroeconomic news, media bias, or delayed market reactions, which could weaken the signal or introduce confounding effects.

4.3 Market and Commercial Implications

- **Short-term market volatility**: Sudden policy shifts like defense spending can trigger rapid but temporary changes in sovereign yields and investor sentiment.
- **Investor risk signaling**: Widening yield spreads serve as early indicators of elevated country-specific credit risk.
- **Sentiment as a risk proxy**: News tone and public discourse can supplement traditional financial data in tracking political risk.
- **Potential for early warning tools**: Clustering techniques offer scalable solutions for monitoring sovereign risk using publicly available data.

4.4 Client Actions and Applications

- Integrate bond spread and sentiment monitoring into daily risk dashboards to detect early signs of political stress.
- Use clustering-based alerts to inform portfolio hedging or exposure adjustments during high-risk periods.

5 Product Development Next Steps

While the unsupervised clustering approach successfully identified high-risk periods, several improvements could enhance the index's sensitivity:

- **Feature expansion**: Incorporate additional variables such as CDS spreads, FX rates, or social media sentiment for broader coverage.
- **Temporal smoothing**: Apply rolling averages or time-aware clustering to reduce noise and capture sustained risk trends.
- **Country-level differentiation**: Separate Italy-specific shocks from Eurozone-wide dynamics by modeling control countries more explicitly.
- **Model calibration**: Experiment with different numbers of clusters or switch to density-based methods (e.g., DBSCAN) to capture more nuanced regimes.