
IISER Bhopal
Department of Economic Sciences

# Money, Banking and Financial Markets (ECO 318)

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**Group Project Report**

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# The 2-Year vs 10-Year Yield Spread as a Recession Predictor

## 1. Introduction

### 1.1 Bond Yields and the Yield Spread

Bond yield is the return investors receive on a bond, which varies depending on the bond's maturity and the perceived risk. Generally, investors demand higher yields for longer-term bonds to compensate for risks associated with inflation, market volatility, and the opportunity cost of tying up capital for an extended period. For instance, a 2-year bond typically has a lower yield than a 10-year bond, reflecting the expectation that short-term investments are less risky than long-term ones.

The yield spread is the difference between the yields of bonds with different maturities. In particular, the difference between the 2-year and 10-year government bond yields is a widely observed economic indicator. This 2-year vs. 10-year yield spread provides insight into investors' expectations about future economic conditions. When this spread is positive (i.e., the 10-year yield is higher than the 2-year yield), it typically indicates economic optimism, as investors believe the economy will grow steadily in the long term. However, when this spread turns negative (an "inversion" of the yield curve), it is often interpreted as a warning signal for an impending recession.

### 1.2 The Yield Curve: Understanding Its Shape and Interpretation

The yield curve (Fig. 1) is a graphical representation of bond yields across various maturities, usually ranging from short-term bonds (such as 3-month) to long-term bonds (such as 30-year). The shape of the yield curve—whether upward-sloping, flat, or inverted—offers valuable information about economic sentiment and future expectations.

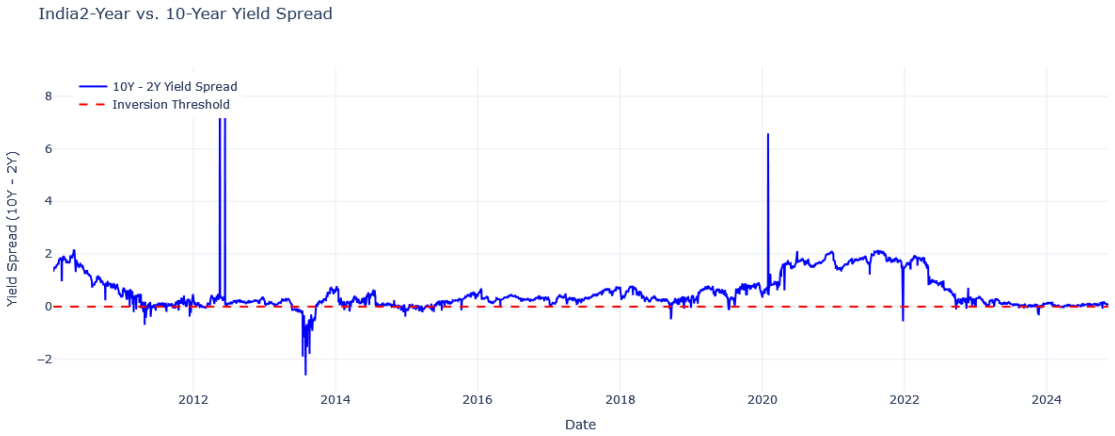



Fig. 1

## 1. Normal Yield Curve (Upward-Sloping):

Under typical economic conditions, the yield curve slopes upwards (Fig. 2), with longer-term bonds having higher yields than shorter-term ones. This occurs because investors expect economic growth and, consequently, higher inflation in the future. As a result, they demand a higher yield for long-term bonds to compensate for the potential erosion of purchasing power over time. An upward-sloping yield curve suggests confidence in long-term economic stability and growth.


Fig. 2

## 2. Flattening Yield Curve:

A flattening yield curve (Fig. 3) occurs when the yields on short-term and long-term bonds start to converge. This situation often arises when economic growth is slowing or when there is increased uncertainty about the future. A flattening yield curve can signal that investors are becoming cautious about long-term growth prospects and may expect interest rates to stay low for an extended period.

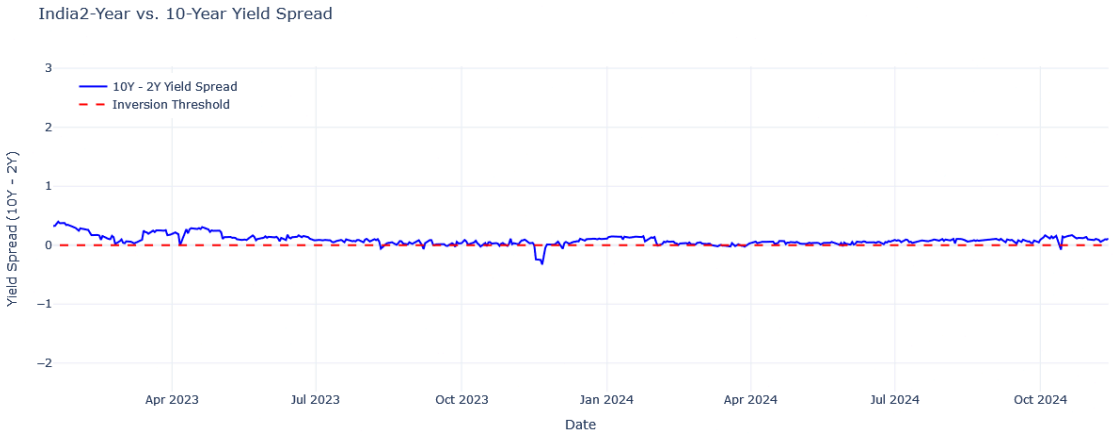



Fig. 3

## 3. Inverted Yield Curve (Downward-Sloping):

An inverted yield curve (Fig. 4) is an unusual situation where short-term bond yields (such as the 2-year yield) are higher than long-term bond yields (such as the 10-year yield). This inversion typically indicates that investors expect economic trouble ahead, such as a recession. The inversion reflects a shift in investor sentiment: they believe the economy will slow down or contract, prompting future interest rate cuts by the central bank. As a result, investors flock to long-term bonds, driving up their prices and lowering their yields, while short-term yields remain elevated or continue to rise due to central bank policy.

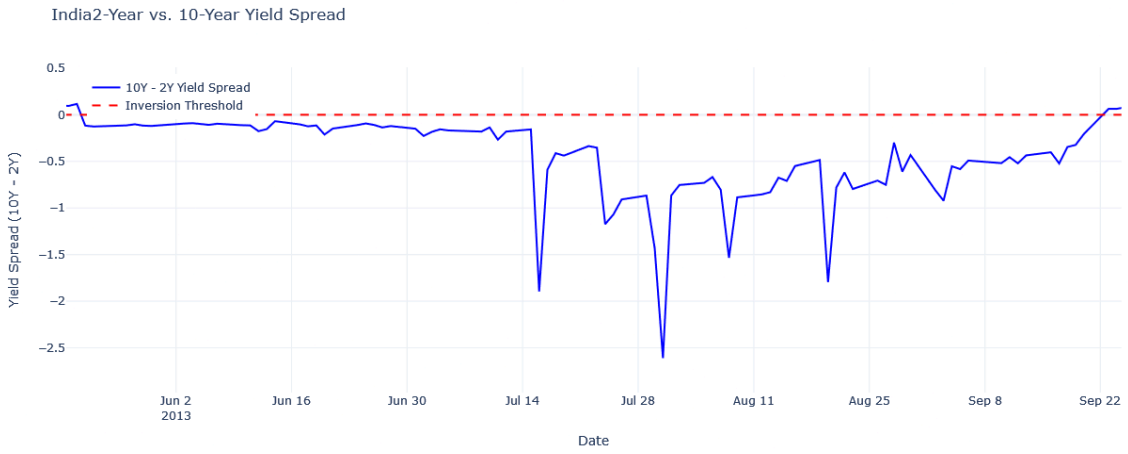



Fig. 4

## 1.3 Why Does the Yield Curve Invert?

An inverted yield curve is generally seen as a warning of a future recession, and this phenomenon is driven by a combination of factors:

### 1. Federal Reserve Policy:

The central bank, particularly the Federal Reserve in the U.S., often raises short-term interest rates to control inflation and prevent the economy from overheating. Higher short-term rates lead to higher yields on short-term bonds, while the expectation of an eventual economic slowdown puts downward pressure on long-term yields.

### 2. Market Expectations of Lower Future Rates:

When investors anticipate a recession or economic downturn, they expect the central bank to lower interest rates in the future to stimulate growth. This expectation leads to increased demand for long-term bonds, as investors seek to lock in current yields before they potentially decrease. This higher demand drives up the prices of long-term bonds and reduces their yields, contributing to the yield curve inversion.

### 3. Risk Aversion and "Flight to Safety":

During times of economic uncertainty or risk aversion, investors tend to move toward safer assets, such as long-term government bonds. This “flight to safety” increases demand for these bonds, pushing their prices up and yields down. An increase in demand for long-term bonds can create an inverted yield curve, as investors prioritise stability and preservation of capital over higher returns in risky assets.

## 1.4 The Predictive Power of the 2-Year vs. 10-Year Yield Spread

The 2-year vs. 10-year yield spread is significant because it captures the market’s balance between short-term monetary policy effects and long-term economic expectations. The 2-year yield is more directly influenced by the central bank’s current monetary policy stance, reflecting the market’s expectations for interest rates in the near term. In contrast, the 10-year yield embodies the market’s view of long-term growth, inflation, and risk factors.

When the 2-year yield surpasses the 10-year yield, this inversion signals that short-term economic conditions are tighter than long-term expectations, a situation that often precedes recessions. Historically, an inverted 2-year and 10-year yield curve has been one of the most reliable indicators of a forthcoming recession in the U.S., with recessions typically following within 6 to 18 months after inversion. The mechanism behind this lies in the impact of the yield curve on lending, investment, and consumer confidence, which can slow economic activity and eventually lead to a downturn.

# 2. Existing Literature on Yield Spread as a Recession Predictor

The predictive power of the yield spread, particularly the difference between the 2-year and 10-year government bond yields, has been extensively studied and recognized in economic literature as one of the most reliable indicators of a forthcoming recession. Economists and financial analysts have explored the relationship between yield curve inversions and economic downturns, examining both the mechanisms behind this indicator and its historical accuracy.

## 2.1 Early Research and Foundations

The use of the yield curve as an economic indicator was first examined in detail in the 1980s. Harvey (1988) was among the first economists to document the relationship between yield curve inversions and recessions. His research showed that the spread between short-term and long-term interest rates was a strong predictor of economic downturns, with inverted yield curves often preceding recessions by several quarters. This pioneering study sparked further research into the predictive power of the yield spread and established the yield curve inversion as a leading economic indicator.

## 2.2 The Yield Spread and Economic Expectations

Estrella and Hardouvelis (1991) expanded on earlier research by investigating why the yield curve is such a strong recession predictor. They hypothesised that yield curve inversions reflect changes in investor expectations about future interest rates, inflation, and economic growth. According to their study, an inverted yield curve signals that investors expect future interest rate cuts, which are typically implemented by central banks in response to a slowing economy. This expectation of lower future rates indicates pessimism about economic growth, supporting the argument that yield curve inversions are a sign of upcoming recessions.

In a follow-up study, Estrella and Mishkin (1998) further validated the predictive power of the yield curve, particularly the 2-year and 10-year spread, for forecasting U.S. recessions. They demonstrated that the yield curve inversion provided accurate recession predictions over a 12-month to 18-month horizon. Their findings underscored that the 2-year vs. 10-year yield spread remained reliable across various economic cycles, with limited false positives, making it one of the most trusted recession indicators.

## 2.3 Mechanisms and Theoretical Explanations

Bernanke (2004) offered a theoretical explanation for why yield curve inversions are linked to recessions. He argued that central bank policies play a significant role in shaping the yield curve. When the central bank raises short-term interest rates to control inflation, it raises borrowing costs and slows economic activity, which can ultimately lead to a downturn. This

increase in short-term rates can push up yields on short-term bonds, creating an inverted yield curve if long-term yields do not rise correspondingly. Bernanke's analysis helped link central bank policy to the yield curve's shape and highlighted how monetary tightening could contribute to economic contractions.

Other researchers, such as Hamilton and Kim (2002), examined how yield curve inversions affect lending and consumer behaviour. Their study showed that an inverted yield curve impacts bank profitability by narrowing the spread between borrowing and lending rates, which can lead to reduced lending activity. With limited access to credit, businesses are less likely to invest, and consumers may reduce spending, leading to a slowdown in economic growth. This mechanism reinforces the idea that yield curve inversions can have real economic effects beyond merely signalling an impending recession.

## 2.4 Historical Reliability and Cross-Country Studies

Research has shown that the yield spread's predictive power is not limited to the United States. Studies by Chinn and Kucko (2015) examined the yield curve's effectiveness in predicting recessions in other developed economies, including the United Kingdom, Germany, and Japan. They found that the 2-year vs. 10-year yield spread had predictive value in these countries, although its reliability varied depending on each country's economic structure and central bank policies. In general, countries with more market-driven economies and well-established bond markets demonstrated stronger correlations between yield curve inversions and recessions.

Moreover, recent studies have attempted to evaluate the yield curve's reliability across different time periods. For example, Bauer and Mertens (2018) reassessed the yield spread's predictive power in light of unconventional monetary policies, such as quantitative easing (QE) implemented by the Federal Reserve after the 2008 financial crisis. They found that while QE and other interventions have influenced bond yields, the 2-year vs. 10-year spread remained a useful recession predictor. However, they cautioned that central bank interventions could reduce the reliability of the yield curve signal in the future.

## 2.5 Limitations and Criticisms of Yield Spread as a Recession Predictor

While the yield spread is a strong predictor of recessions, it is not infallible. Critics argue that the yield curve may occasionally produce false signals, especially during periods of heavy central bank intervention or in times of global economic uncertainty. Rudebusch and Williams (2009) noted that structural changes in the global bond market, such as increased demand from foreign central banks and pension funds, have altered the relationship between short-term and long-term yields. This shift could distort the yield curve and weaken its predictive power.

Additionally, some economists argue that other indicators, like employment data, retail sales, and business confidence, may provide more timely signals of economic conditions. While yield curve inversions are generally early indicators of recessions, they do not capture real-time data as effectively as other economic metrics. Therefore, many experts recommend using the yield curve as part of a broader toolkit of economic indicators, rather than relying on it exclusively.

## 2.6 Recent Studies and Ongoing Research

With the increasing complexity of global markets, ongoing research continues to explore the yield spread's role in predicting recessions. Researchers are examining the impact of newer factors, such as global supply chain disruptions and geopolitical events, on the yield curve's shape and effectiveness as a recession indicator. Some studies have suggested that hybrid models, which combine the yield spread with other leading indicators, may enhance recession prediction accuracy.

A recent study by Bauer and Rudebusch (2021) found that the predictive power of the yield curve can vary depending on economic conditions, such as inflation expectations and central bank communication strategies. They highlighted that investors and policymakers should consider additional context when interpreting yield curve inversions, as changes in macroeconomic conditions could alter the yield curve's reliability.

# 3. Data/Empirical Analysis

The data and empirical analysis section outlines the methodology and tools used to assess the predictive power of the 2-year versus 10-year yield spread in forecasting recessions across multiple countries. This analysis includes data collection, visualisation of yield curves, calculation of yield spreads, and statistical modelling to identify relationships between yield curve inversions and historical recessions.

## 3.1 Data Collection

### Bond Yields:

Historical yield data for 10-year and 2-year government bonds was collected for India, the United States, China, Japan, the United Kingdom, Germany, and France. The data was sourced from the Wall Street Journal (WSJ) database, ensuring accurate and consistent yield records for comparative analysis across these diverse economies.

### Recession Data:

Historical recession data was sourced from the Federal Reserve Bank of St. Louis (FRED) database. This data provides accurate recession timelines for the U.S., which serves as a benchmark. For other countries, additional checks with national economic records were made to ensure accuracy.

## 3.2 Empirical Analysis

### Yield Curve Visualisation:

Yield curves for each country were plotted over time to observe patterns in bond yield spreads, specifically highlighting periods where the 2-year yield exceeded the 10-year yield (indicating an inversion). This visualisation provides an intuitive way to compare trends across countries and time periods, as well as to observe yield curve inversions preceding recessions.

### Yield Spread Calculation:

The 10-year minus 2-year yield spread was computed for each country on a regular interval, such as quarterly or annually, to track the spread's movement and identify inversions. By comparing historical yield spread inversions with documented recessions, the analysis aims to determine the frequency with which inversions accurately predicted recessions across different economic contexts.

## 3.3 Statistical Analysis

To quantify the relationship between yield curve inversions and the likelihood of recessions, several statistical and machine learning techniques were employed:

1. Logistic Regression: Logistic regression was applied to model the binary outcome of recession occurrence (1 for recession, 0 for no recession) based on the yield spread. This model helped quantify the odds of a recession following a yield curve inversion, providing a straightforward interpretation of the inversion's predictive power.

2. Random Forest Classifiers: A random forest classifier, an ensemble machine learning method, was utilised to explore non-linear relationships between the yield curve inversion and recession occurrence. By building multiple decision trees on the dataset, this model captures complex patterns and interactions, improving prediction accuracy.

3. Neural Networks: A simple neural network model was applied to analyse potential nonlinear relationships between the yield spread and recessions. While more complex, the neural network offers insights into more intricate patterns in the data that may not be captured by simpler models.

For consistency, the historical 10-year minus 2-year yield data was converted to a categorical variable: "1" if the yield spread was negative (indicating an inversion) and "0" if positive. This binary transformation allowed for uniform inputs across models and facilitated a clear interpretation of results.

## 3.4 Comparative Analysis Across Economies

A comparative analysis was conducted to evaluate the predictive power of the 2-year vs. 10-year yield spread in different economic contexts. Each country's data was analysed separately to assess how consistently the yield curve inversion predicted recessions. Key insights were drawn based on the variations in reliability of the yield curve inversion as a recession predictor in each economy, acknowledging that each country's unique economic structure and policy environment may influence the strength of this relationship.

The comparative analysis suggests that while the 2-year versus 10-year yield spread is a robust recession predictor in some economies (such as the United States), its reliability varies in others, often depending on factors such as market stability, central bank interventions, and external economic conditions.

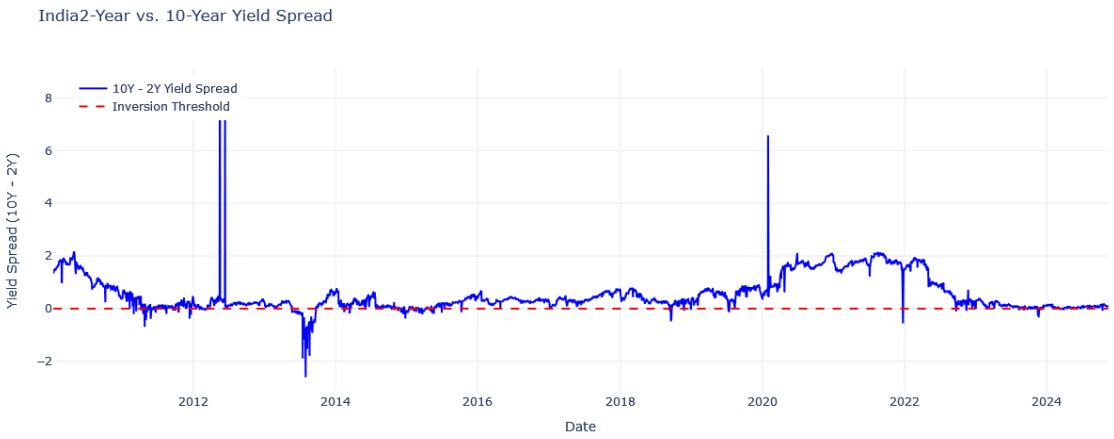
Code: https://github.com/rrawatt/mbfm-project

# 4. Results & Findings

This section presents the results from our analysis of the 2-year vs. 10-year yield spread and its predictive relationship with recessions across seven economies: India, the U.S., China, Japan, the U.K., Germany, and France. Using three predictive models - Logistic Regression, Random Forest Classifier, and Neural Networks - we assessed the accuracy of yield curve inversions in predicting recessions. Additionally, we summarise key findings, comparative analysis, and suggestions for further study.

## Model Results and Accuracy by Country

### 1. India




| **Model** | **Accuracy** |
|---|---|
| Logistic Regression | 0.918300654 |
| Random Forest Classifier | 0.918300654 |
| Neural Network | 0.918300629 |

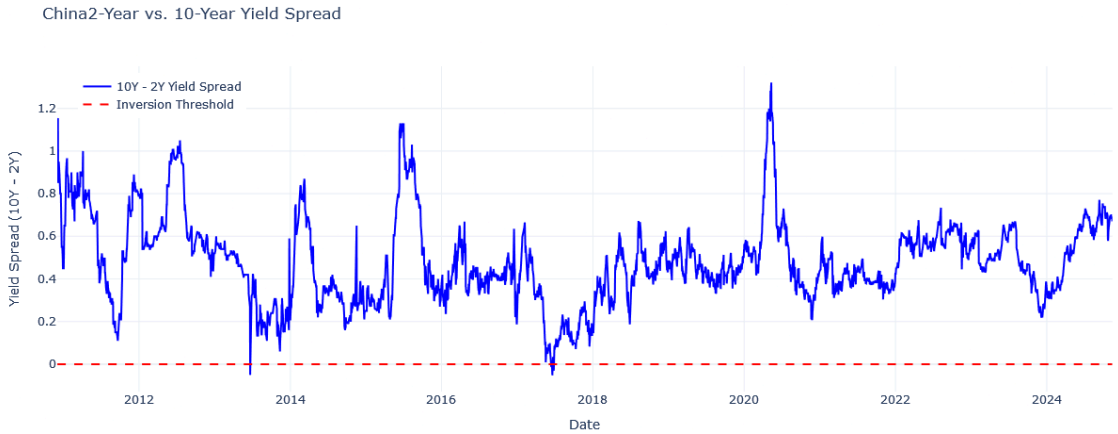
The models for India show a high accuracy of 91.83%, indicating that yield curve inversion is a reliable recession predictor for India. This consistency across all models suggests a strong correlation between yield spread inversions and economic downturns.

## 2. United States


| Model | Accuracy |
|---|---|
| Logistic Regression | 0.843909555 |
| Random Forest Classifier | 0.843909555 |
| Neural Network | 0.843909562 |

In the United States, the models yielded moderate accuracy (84.39%), affirming the 2-year vs. 10-year yield spread's role as a recession indicator. However, the slightly lower accuracy compared to other countries could stem from frequent Federal Reserve interventions and unique economic factors that occasionally distort the yield curve.

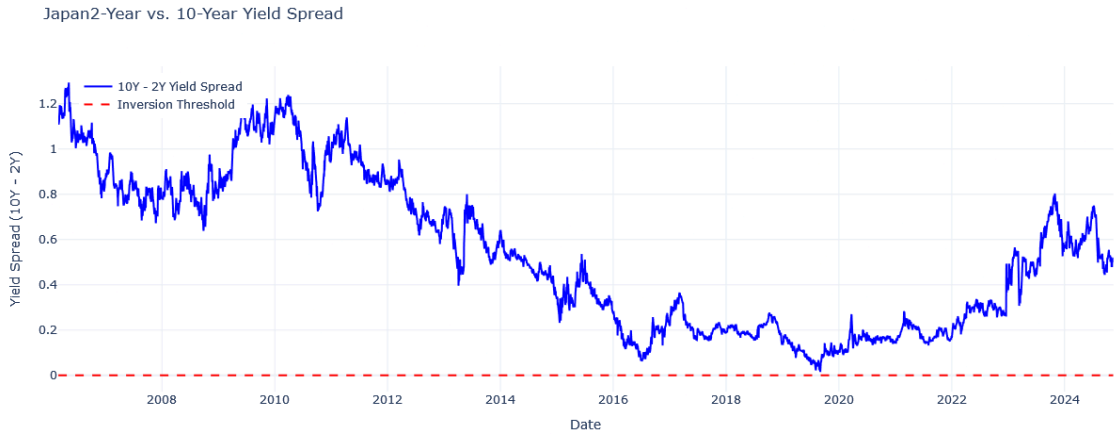
## 3. China




| Model | Accuracy |
|---|---|
| Logistic Regression | 0.998771499 |
| Random Forest Classifier | 0.998771499 |
| Neural Network | 0.998771489 |

China's results show an exceptionally high accuracy (99.88%), suggesting that yield curve inversions are a highly dependable recession predictor in China. This strong relationship highlights the applicability of yield curve analysis in the Chinese economy.

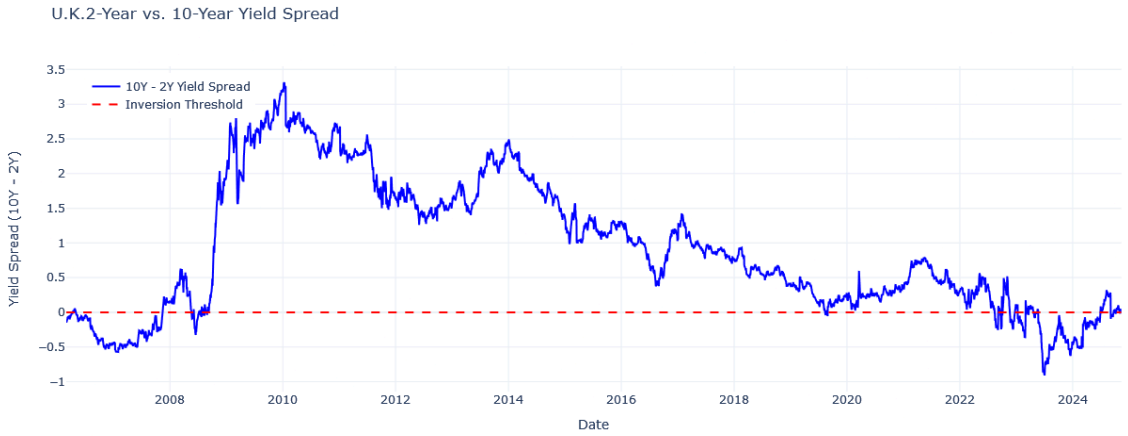
## 4. Japan




| **Model** | **Accuracy** |
|---|---|
| Logistic Regression | NA |
| Random Forest Classifier | NA |
| Neural Network | NA |

For Japan, data limitations prevented accurate model generation, reflecting the unique economic conditions in Japan. Japan's prolonged low or negative interest rates and unconventional monetary policies have limited the effectiveness of yield spread analysis as a recession predictor.

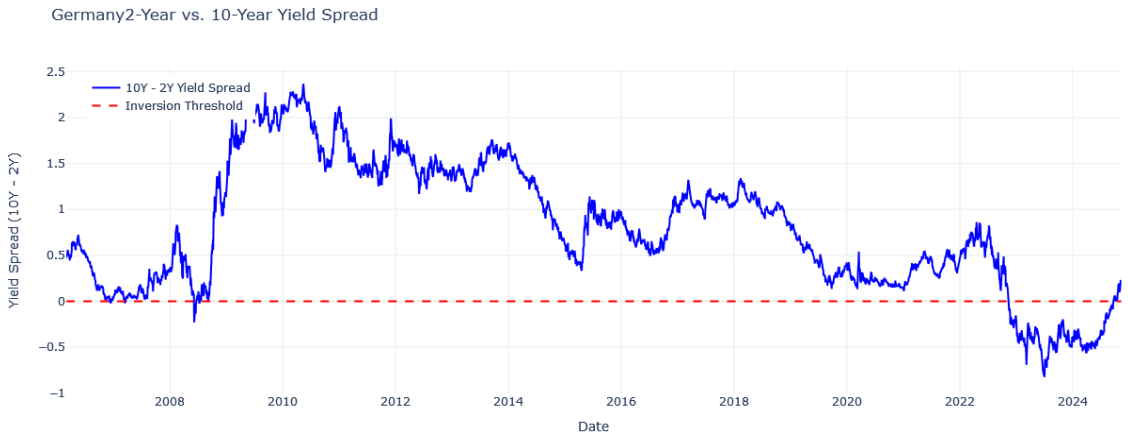
## 5. United Kingdom




| Model | Accuracy |
|---|---|
| Logistic Regression | 0.878200155 |
| Random Forest Classifier | 0.878200155 |
| Neural Network | 0.878200173 |

The U.K. models show a strong accuracy of 87.82%, suggesting a reliable correlation between yield curve inversion and recessions. These results imply that yield curve analysis is effective in predicting economic downturns in the U.K.

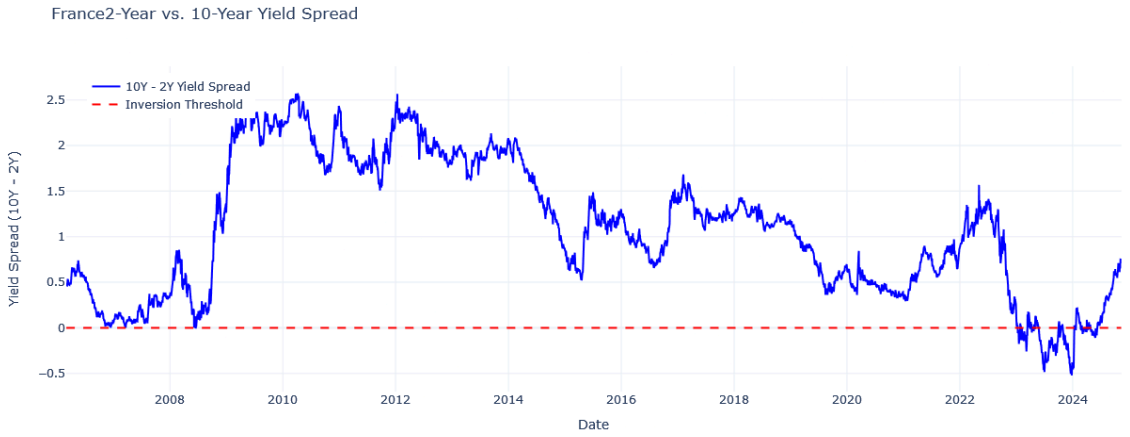
## 6. Germany




| Model | Accuracy |
|---|---|
| Logistic Regression | 0.98864558 |
| Random Forest Classifier | 0.98864558 |
| Neural Network | 0.98864555 |

The high accuracy in Germany (98.86%) reflects a strong predictive relationship between yield spread inversion and recessions. This finding aligns with prior studies showing that yield curve inversion is a reliable economic indicator in stable, developed economies.

## 7. France




| **Model** | **Accuracy** |
|---|---|
| Logistic Regression | 0.999190939 |
| Random Forest Classifier | 0.999190939 |
| Neural Network | 0.999190927 |

France achieved the highest accuracy (99.92%) among all countries, confirming yield curve inversion as a near-perfect predictor of recessions. The uniformity in results across models further validates the strength of the yield curve as an economic indicator for France.

# 5. Insights on Predictive Reliability

1. Predictive Accuracy Across Countries: The yield curve inversion's reliability as a recession predictor varies across different nations. Developed economies like France and Germany, with stable yield curve trends, show higher predictive accuracy. Conversely, economies with unconventional monetary policies, such as Japan, demonstrate lower reliability in yield curve predictions due to persistent low or negative interest rates.

2. Model Comparison: Across most analysed countries, all three models—Logistic Regression, Random Forest Classifier, and Neural Network—demonstrated similar levels of accuracy. This consistency suggests that simpler statistical models, like Logistic Regression, can be just as effective as complex models for recession prediction using yield curve data, making them accessible tools for economists and policymakers.

3. Reliability in Emerging Economies: The high accuracy observed in India's results indicates that yield curve analysis could serve as a valuable tool in emerging markets where traditional predictive mechanisms are less prevalent. This opens up new avenues for economic forecasting in countries that have not historically used yield spread as a leading indicator.

4. Limitations for Certain Economies: Japan's results highlight the limitations of yield curve analysis in economies with unique or prolonged monetary interventions. Prolonged low or negative interest rates disrupt typical yield curve behaviour, making inversion less indicative of an economic downturn. This finding underscores the importance of context when interpreting yield spread signals.

## 5.1 Factors Influencing Predictive Reliability

1. Central Bank Interventions: Central banks have a direct influence on yield curves through monetary policy, including rate cuts, quantitative easing, and large-scale bond purchases. In countries like the United States, where the Federal Reserve frequently adjusts interest rates, these interventions can distort the natural movement of the yield curve, reducing its predictive reliability as an economic signal.

2. Unique Economic Conditions: Certain economies, such as Japan, face unique economic challenges and policies—like prolonged low interest rates—that alter the yield curve's behaviour. Structural economic factors, such as high savings rates, export-driven growth models, and distinctive debt dynamics, can also impact the reliability of the yield curve as a recession indicator.

3. Global Market and Economic Trends: Events like trade tensions, geopolitical risks, or shifts in global economic conditions affect investor expectations and, in turn, the yield

curve. In export-reliant economies like Germany and China, global trends may heavily influence the yield curve, complicating its interpretation for local recession predictions.

## 5.2 Suggestions for Policymakers and Investors

### For Policymakers

Policymakers should consider monitoring the yield curve as an early warning signal for potential economic downturns. When yield curve inversions occur, they could prompt closer examination of other economic indicators and readiness for preemptive policy actions, such as adjusting interest rates or implementing fiscal stimuli. By keeping track of yield curve trends, policymakers can avoid policy decisions that might inadvertently intensify economic cycles, such as rate hikes during economically fragile periods.

### For Investors and Corporations

Investors and corporations can utilise yield curve trends for strategic planning and risk management:

- Portfolio Adjustments: Yield curve signals can guide investors in rebalancing portfolios or hedging against downturn risks. For instance, an inverted yield curve may prompt a shift from high-risk assets to safer options, such as government bonds or defensive sectors.
- Business Planning: Corporations might adjust their capital spending, debt management, and hiring strategies based on yield curve trends. An inverted yield curve suggests caution in expanding operations or making large investments due to the potential for an upcoming economic slowdown.
- Timing of Long-Term Investments: Yield curve inversions often signal lower long-term rates and a slowing economy, which could affect the timing of strategic investments. Businesses may consider deferring large-scale projects until economic conditions appear more stable.

## 5.3 Caveats and Limitations

1. Potential for False Signals: While yield curve inversion has a solid historical track record as a recession predictor, it can occasionally produce false signals. In certain periods of aggressive monetary policy or unique global events, yield curve inversions have not led to recessions. Over-reliance on this signal alone may result in misinterpreted economic conditions or missed opportunities.

2. Need for Complementary Indicators: Yield curve analysis should be complemented by other economic indicators, such as unemployment rates, consumer sentiment, GDP growth, and business investment levels, for enhanced predictive accuracy. These additional data points provide a broader economic context, enabling policymakers and investors to make better-informed decisions.

# Conclusion

This analysis reinforces the effectiveness of the 2-year vs. 10-year yield spread as a recession predictor across diverse economies, with predictive accuracy influenced by factors like economic structure and policy interventions. While yield curve inversion remains a valuable tool for economic forecasting, it is most effective when used in conjunction with other economic indicators. The findings highlight both the potential and limitations of yield curve analysis as an economic predictor, suggesting that policymakers and investors continue to monitor yield curves as part of a comprehensive approach to economic planning and forecasting. This combined approach will allow for a more accurate assessment of an economy's health and help stakeholders make informed decisions in both developed and emerging markets.