

FORECASTING LIKELIHOOD AND SEVERITY OF RECESSIONS IN INDIA:

A MACHINE LEARNING APPROACH

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ABSTRACT

This study develops a two-step machine learning-based framework to forecast the likelihood and severity of recessions in India: The first step predicts the probability of a recession using binary classification, while the second step, conditional on a predicted recession, classifies its severity into three categories using multiclass classification.

A diverse set of machine learning models has been deployed across multiple forecast horizons (3, 6, 9, and 12 months). Key macroeconomic indicators, including the 10-year-1-year government bond yield spread, 1-month weighted call money rate, WPI fuel inflation, and non-oil export, have emerged as consistent and significant predictors of the business cycle in India. Further, the Sub-sample analysis confirms that the inclusion of the Purchasing Managers' Index (PMI) enhances forecasting performance, particularly in predicting the severity of recession in 6-, 9-, and 12- months ahead horizons. Robustness checks using alternative severity categorizations confirm the stability of the model. Machine learning-based classification indicated that India is currently experiencing a recessionary phase, and the recession is likely to persist in the near future but remain mild (or slowdown), with an expected severity range between +2% and -5%. The findings highlight the effectiveness of machine learning in providing early and reliable insights into economic downturns, thereby supporting timely and targeted policy interventions.

Keywords: Business Cycle, Machine Learning, Leading Indicators, India

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LIKELIHOOD AND SEVERITY OF RECESSIONS – FORECAST

Economic activity typically moves through cyclical phases—expansion, peak, recession and trough. These phases capture the directional shifts in growth, from acceleration to contraction. Identifying and quantifying these shifts is essential for anticipating economic turning points.

The severity of economic downturns—measured as the deviation of the Index of Industrial Production (IIP) growth rate from its long-term trend—is segmented into three distinct categories. This classification captures the varying intensity of economic slowdowns and recessions and helps differentiate between early signs of deceleration and deep contractions.

1. “Falling or Descending from Peaks” (Label 0): This category includes periods where the IIP growth rate deviates above +2% from the long-term trend. Though growth remains positive, this phase reflects the early part of a recessionary cycle—typically when the economy is cooling from its peak. This transition from expansion to slower growth often marks the beginning of cyclical weakness.
2. “Mild or Neutral Recessions” (Label 1): Defined by deviations between -5% and +2%, this range characterizes periods of sluggish or below-trend growth. These are considered part of the recessionary phase, reflecting moderate slowdowns where economic activity loses momentum but does not exhibit severe contraction. These periods are observable in situations where the economy struggles but remains relatively stable.
3. “Severe Recessions” (Label 2): A deviation of below -5% from the IIP trend marks this category and represents true recessions—deep and broad-based downturns in industrial activity.

In this framework, Labels 0 and 1 are interpreted as part of the broader recessionary phase, capturing the gradual weakening or stagnation of growth, while only Label 2 is recognized as a true recession due to the severity of contraction. This approach allows for more granular monitoring of industrial cycle dynamics and early identification of deteriorating economic conditions.

The following link provides forecasts of the economic phase, including the severity of any predicted recession. The analysis covers forecast horizons of 3, 6, and 9 months. For each

horizon, the independent variables (X) are aligned to lead the dependent variable (Y) by the corresponding period. For example, in the 3-month forecast model, X values from April 2025 are used to predict Y for July 2025. This rolling method continues throughout the sample and is replicated for the 6- and 9-month horizons. This approach ensures the chronological integrity between leading indicators and economic outcomes.

The analysis is structured into two distinct components: in-sample and out-of-sample evaluation. The ML Model is trained using data from April 2005 up to April 2024. Out of sample forecasts are made from May 2024 onward.

Forecast Data Link:

<https://docs.google.com/spreadsheets/d/1ZHCYXMFyC6TMVHVKP0BjKVnfc7fYbJfnzsExzOVAm7c/edit?usp=sharing>