Revenue Forecast for ADI's Quarterly Requested Shipment

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Problem

Analog Devices Inc. (ADI) has heavily relied on historical first-party data to optimize its sales account coverage resource allocation, resulting in inaccurate future revenue forecasts.

Objective

Forecast ADI's 5-year revenue incorporating external features on market conditions, industry trends, seasonality, and macroeconomic status.

Data

2006 - 2024
modeling period

~540
parent companies

~16.7K
unique IDs

- historical quarterly requested shipments
- Product Lifecycle Curve (PLC) predictions

amazon REDSHIFT

- customer companies'
  - revenue
  - inventory
  - market cap, etc.
- semiconductor industry shipment revenue by region

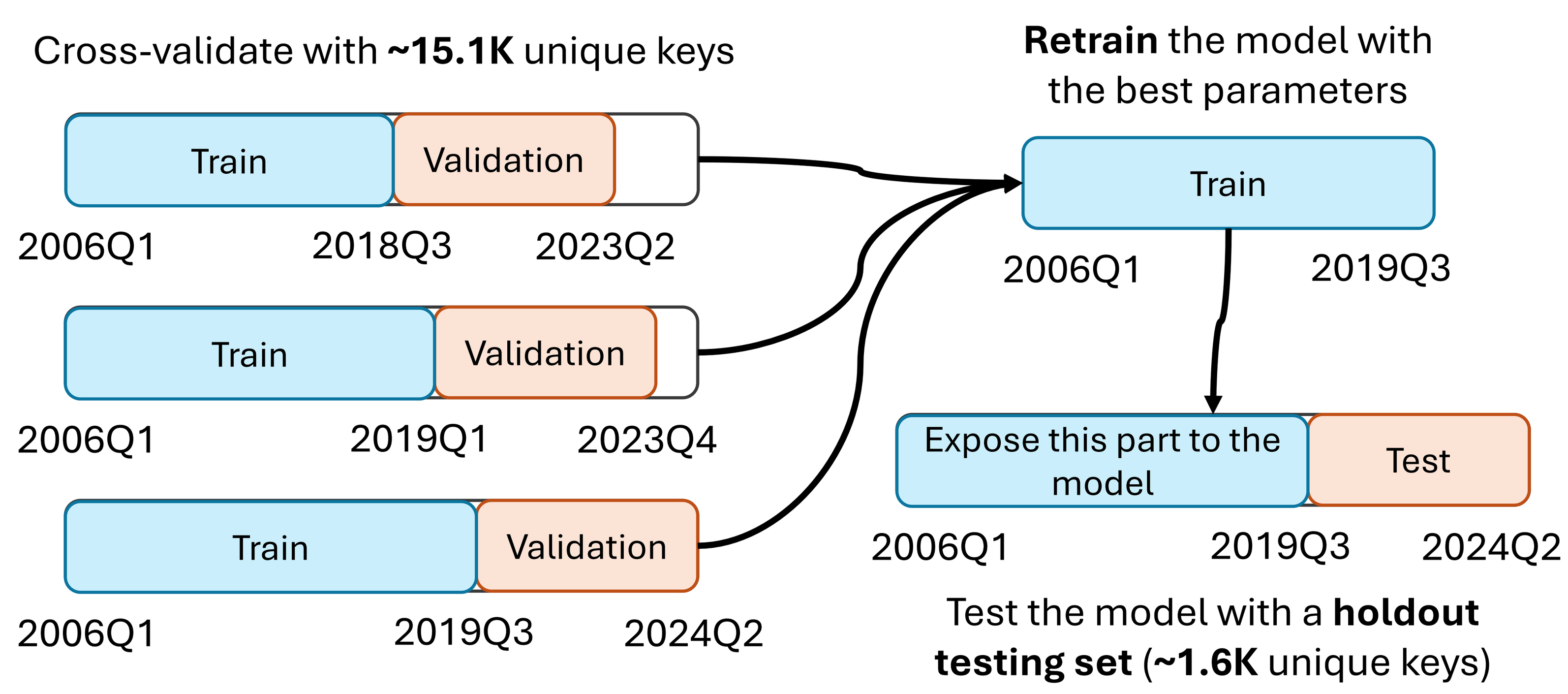
S&P Global OMDIA

- consumer price index
- interest rate
- exchange rate
- PMI

THE WORLD BANK ISM

Methodology

Cross-Validation for Time-Series



Evaluation Metric Selection

Weighted Mean Absolute Percentage Error (WMAPE):

$$\frac{\sum_{j=1}^{n}\left|Actual_j - Forecast_j\right|}{\sum_{j=1}^{n} Actual_j}$$

- where n = #quarters
- emphasizes prediction error at every single quarter

Revised WMAPE:

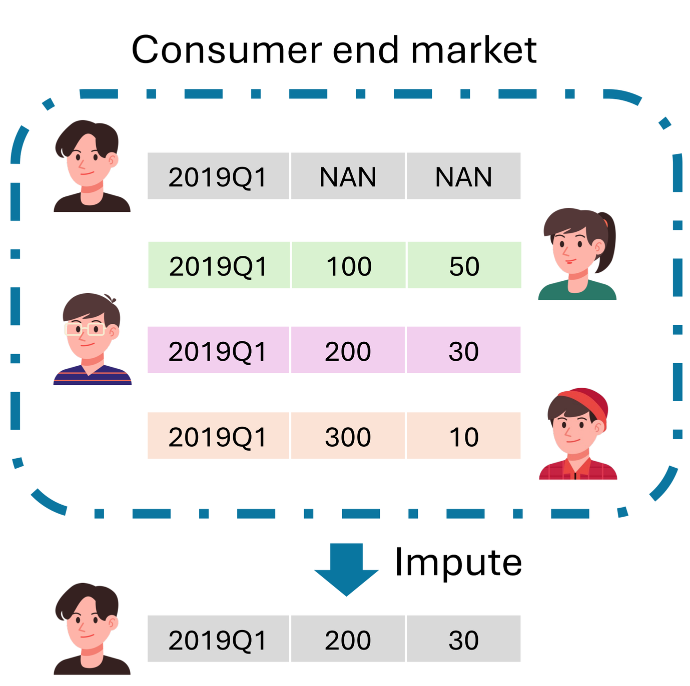
$$\frac{\sum_{i=1}^{m}\left|\sum_{j=1}^{4} Actual_j - \sum_{j=1}^{4} Forecast_j\right|}{\sum_{j=1}^{n} Actual_j}$$

- where n = #quarters, m = #years
- emphasizes prediction error every 4 consecutive quarters

Dealing with Sparse Data

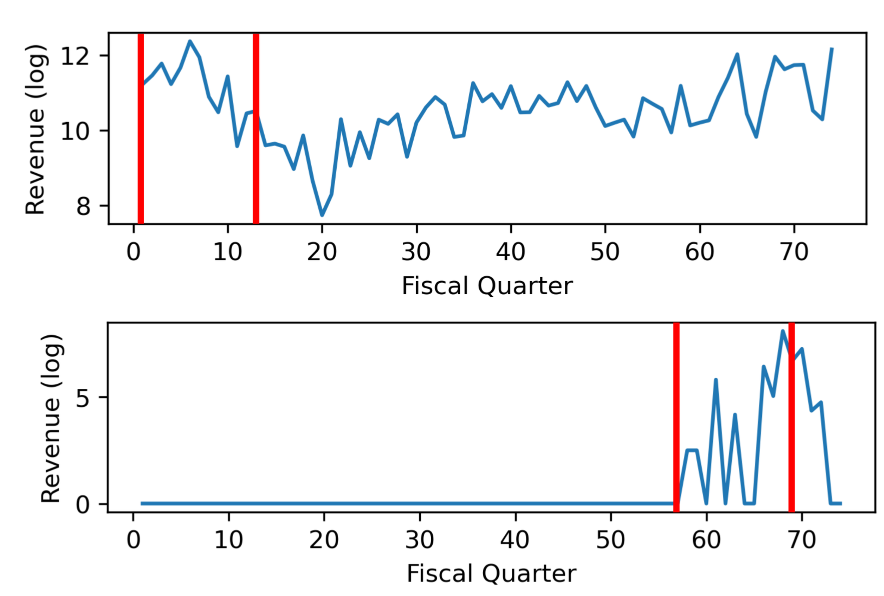
1. External features:

Impute by median from similar companies operating in the same end market



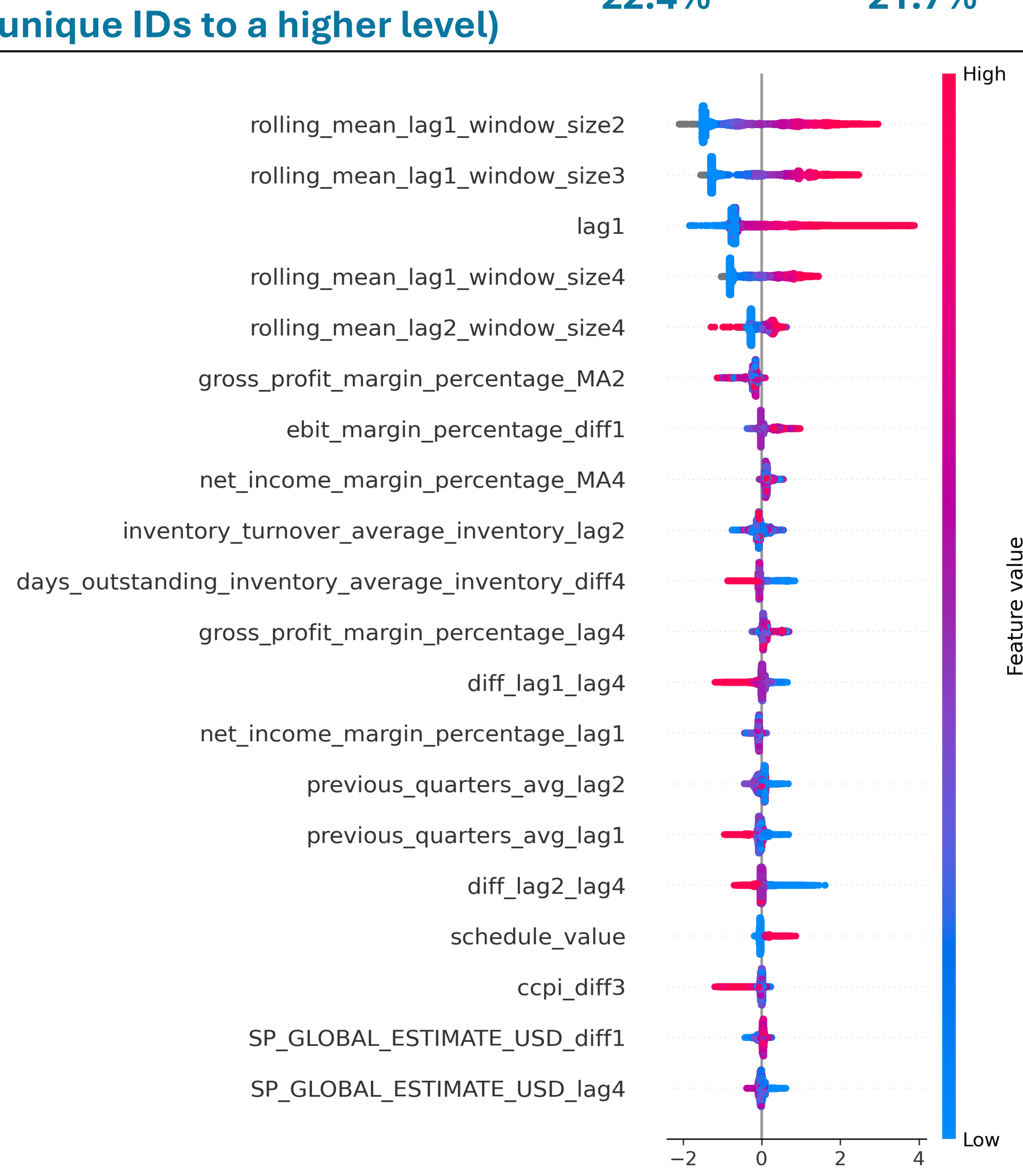
2. Target variable:

Filter to unique keys with non-zero shipment in at least 75% of the quarters in any 3 consecutive years

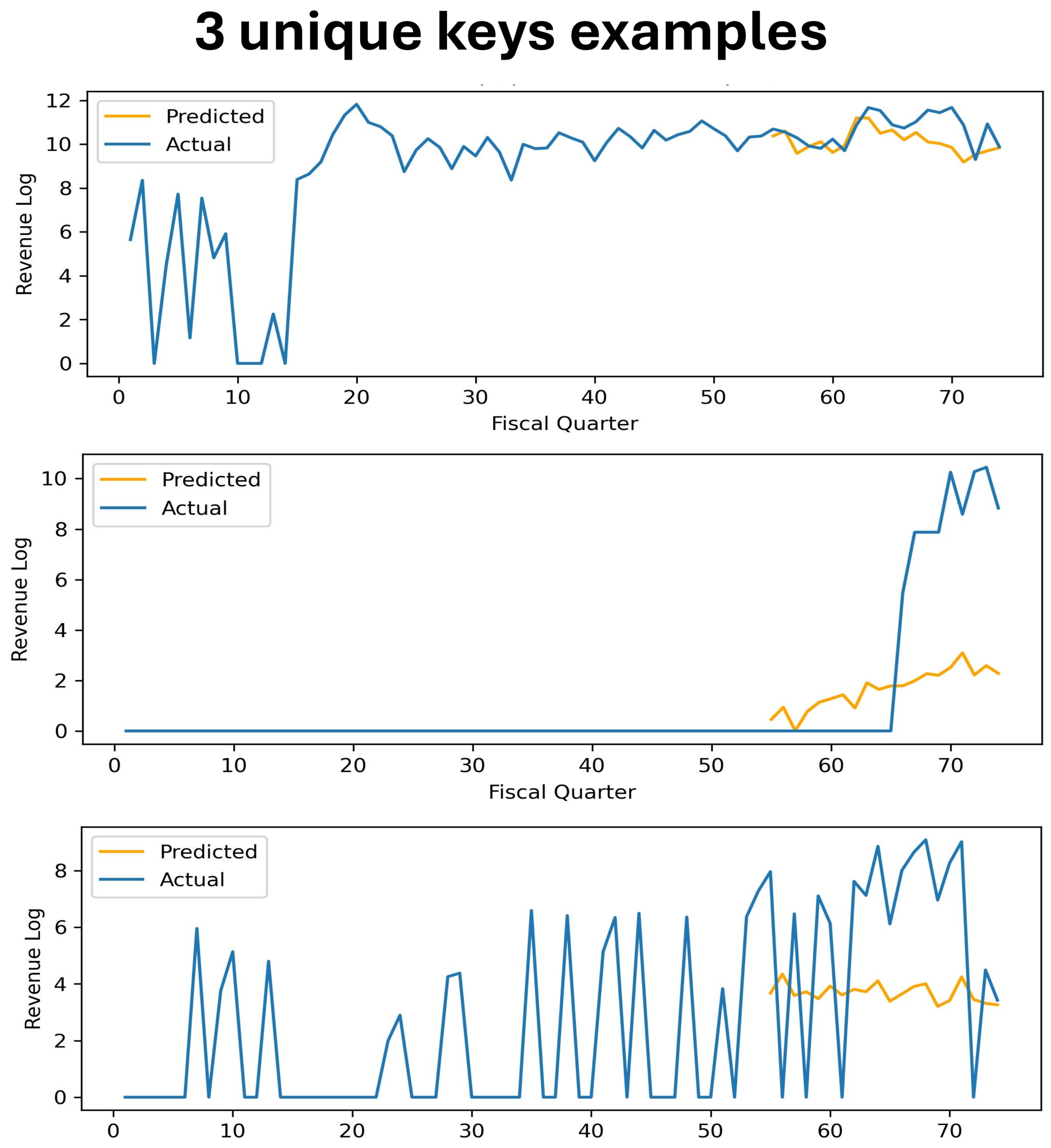


Results

Model	WMAPE Train	WMAPE Test
AR	31.4%	63.1%
MA	41.2%	60.0%
LSTM	70.0%	66.7%
XGBoost	27.4%	47.7%
LightGBM	32.8%	31.5%
LightGBM (aggregated unique IDs to a higher level)	**22.4%**	**21.7%**



Actual vs. Forecasted Revenue: 3 unique keys examples



Sufficient past shipments
- Accurate trend

Mostly zero past shipments
- Upward trend

Fluctuated past shipments
- Near-constant line

Business Impact

Accurately forecasting ADI customers' revenues can help:

- The sales team set realistic goals and incentive plans
- Guide optimal allocation of staffing, capital, and time
- Identify fast-growing accounts to enhance relationships and growth

Prepare the data → Forecast values for the features → Apply the model to forecast the revenue

Next Steps

To further improve the model performance, we can try:

1. Modeling at a higher unique id level
2. Adding more features
3. Obtaining more historical data for the acquired company (MAXIM)
4. Modeling at semi-annual level