Benchmarking Econometric and Machine Learning Methodologies in Nowcasting US GDP

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Introduction

- Many official statistics and SDG indicators, such as GDP, are published with a substantial delay
- Nowcasting can help fill this information gap by creating timely estimates based on data available more quickly
- There are many methodologies in use in the nowcasting literature
- It can be difficult to find an overarching comparison of these methodologies
- It can be even more difficult to figure out how to implement these methodologies for yourself
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Methodologies examined

- ARMA (autoregressive moving average time series models)
- BVAR (Bayesian mixed-frequency autoregression)
- DFM (dynamic factor models)
- decision tree
- gradient boosted trees
- LSTM (long short-term memory artificial neural networks)
- MF-VAR (mixed frequency vector autoregression)
- MIDAS (mixed data sampling regression)
- MLP (multilayer perceptron/feedforward artificial neural network)
- OLS (ordinary least squares)
- random forest
- Ridge regression
Additional methodologies examined in the rewrite

- DeepVAR
- Elastic net
- Lasso
- Midasml
- XGBoost
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US GDP, as a commonly nowcasted variable, was chosen as the benchmark target variable.

All data were from the Federal Reserve Economic Data (FRED) API.

Explanatory variables used were those identified in Bok et al. (2018).
Analysis

- Three separate test periods were assessed, the early 1980s US recession (first quarter of 1972 to the fourth quarter of 1983), the 2008 financial crisis (first quarter of 2005 to the fourth quarter of 2010), and the COVID crisis (first quarter of 2016 to the third quarter of 2021)
- Models were trained with data up until the beginning of the test period and tested on five different artificial vintages
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Results

The graph illustrates the scaled performance of various econometric and machine learning methodologies in nowcasting US GDP. The methodologies include LSTM, Bayesian VAR, MIDAS, DFM, Ridge, MLP, MF-VAR, Random Forest, Gradient Boost, OLS, ARMA, and Decision Tree. The performance is measured on a scale from 0.00 to 1.00, with higher values indicating better performance in nowcasting.
• The two best-performing methodologies in terms of performance were the LSTM and BVAR
• However, the BVAR was much more volatile in its revisions
• More insight to each methodology’s characteristics and performance can be found in the full paper and the repository
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Conclusion

- The paper and repository provide a comprehensive overview of the performance of most popular nowcasting and machine learning techniques in nowcasting on a benchmark dataset.
- More importantly, the boilerplate code to implement any of the methodologies on a new dataset is available on the repository.
- The code’s availability should enable existing practitioners to try new methodologies, as well as significantly lower the barrier for experimentation for potential new practitioners and applications.
Resources

- Full paper
- Benchmark repository
- Original LSTM paper
- UNCTAD nowcasting website
- UNCTAD DFM research paper
- nowcast_lstm library
- For questions please email paper author Daniel Hopp at daniel.hopp@un.org