The validation of machine-learning models for the stress testing of credit risk

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Abstract   Banking supervisors need to know the amount of capital resources required by an institution to support the risks taken. Traditional approaches, such as regulatory capital ratios, have proven inadequate, giving rise to stress-testing as a primary tool. The macroeconomic variables that supervisors provide to institutions for exercises such as the Comprehensive Capital Analysis and Review (CCAR) programme represent a critical input into this. A common approach to segment-level modelling is statistical regression, like vector autoregression (VAR), to exploit the dependency structure between macroeconomic drivers and modelling segments. However, linear models such as VAR are unable to model distributions that deviate from normality. This paper proposes a challenger approach in the machine-learning class of models, widely used in the academic literature, but not commonly employed in practice: the multivariate adaptive regression splines (MARS) model. The study empirically tests these models using Fed Y-9 filings and macroeconomic data, released by the regulators for CCAR purposes. The champion MARS model is validated through a rigorous comparison against the VAR model, and is found to exhibit greater accuracy and superior out-of-sample performance, according to various metrics across all modelling segments. The MARS model also produces more reasonable forecasts according to quality and conservatism.

Keywords: *stress testing, CCAR, DFAST, credit risk, financial crisis, model risk, vector autoregression, multivariate adaptive regression splines, model validation*

INTRODUCTION

In the aftermath of the recent financial crisis,[1,2] regulators have utilised stress testing as a means by which to evaluate the soundness of financial institutions' risk management procedures. The primary means of risk management, particularly in the field of credit,[3] is through advanced mathematical, statistical and quantitative techniques and models, which leads to model risk. Model risk can be defined as the potential that a model does not sufficiently capture the risks it is used to assess, and the danger that it may underestimate potential risks in the future.[4] Stress testing has been used by supervisors to assess the reliability of credit risk models, as can be seen in the revised Basel Framework[5–15] and the Federal Reserve's