Testing for Neglected Nonlinearity in the Conditional Quantile Using Neural Networks*

Georg Keilbar† Weining Wang†‡

April, 2019

Abstract

Neural networks have proved to achieve tremendous success in a large number of prediction problems. Unfortunately, this success comes at the expense of imposing challenges for the interpretation of models and for conducting inference in general.

In this paper, we propose a test for neglected nonlinearity in the conditional quantile by comparing the fit of a linear model to an alternative model constructed as a neural network series estimator. The problem can be formulated as a significance test of the output weight parameters of the neural network in the presence of nuisance parameters under the alternative. We provide consistency and asymptotic normality of the neural network series estimator. We propose three test statistics as functions of a Wald process depending on the nuisance parameters: the *average*, the *exponential average* and the *supremum Wald* statistic. Critical values can be simulated.

Simulations show that our test has proper size and good power. An application to analysis of systemic risk in a financial network indicates an important role of neglected nonlinearity.

JEL classification: C12, C45, C52

Keywords: *Neural networks, quantile regression, nonlinearity test*

*Financial support from the Deutsche Forschungsgemeinschaft via the IRTG 1792 "High Dimensional Non Stationary Time Series", Humboldt-Universität zu Berlin, is gratefully acknowledged. All correspondence may be addressed to the authors by e-mail at georg.keilbar@hu-berlin.de.

†Ladislaus-von-Bortkiewicz Chair of Statistics, School of Business and Economics, Humboldt-Universität zu Berlin

‡Department of Economics, City, University of London.