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# Specification Tests based on MCMC Output*

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**Abstract**

Two test statistics are proposed to determine model specification after a model is estimated by an MCMC method. The first test is the MCMC version of $\text{IOS}_A$ test and its asymptotic null distribution is normal. The second test is motivated from the power enhancement technique of Fan, Liao and Yao (2015). It combines a component ($J_1$) that tests a null point hypothesis in an expanded model and a power enhancement component ($J_0$) obtained from the first test. It is shown that $J_0$ converges to zero when the null model is correctly specified and diverges when the null model is misspecified. Also shown is that $J_1$ is asymptotically $\chi^2$-distributed, suggesting that the second test is asymptotically pivotal, when the null model is correctly specified. The main feature of the first test is that no alternative model is needed. The second test has several properties. First, its size distortion is small and hence bootstrap methods can be avoided. Second, it is easy to compute from MCMC output and hence is applicable to a wide range of models, including latent variable models for which frequentist methods are difficult to use. Third, when the test statistic rejects the null model and $J_1$ takes a large value, the test suggests the source of misspecification. The finite sample performance is investigated using simulated data. The method is illustrated in a linear regression model, a linear state-space model, and a stochastic volatility model using real data.

*JEL classification:* C11, C12, G12
*Keywords:* Specification test; Point hypothesis test; Latent variable models; Markov chain Monte Carlo; Power enhancement technique; Information matrix.

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