

Markov-Switching Models with Unknown Error Distributions

by

Shih-Tang Hwu¹

University of Washington

and

Chang-Jin Kim

University of Washington

September, 2017

(Job Market Paper)

Abstract

To this day, the basic Markov-switching model has been extended in various ways ever since the seminal work of Hamilton (1989). Without exception, however, estimation of Markov-switching models in the literature has relied upon parametric assumptions on the distribution of the error term. In this paper, we first examine the pitfalls of estimating Markov-switching models by maximizing a normal log-likelihood when the normality assumption is violated. We then present a Bayesian approach for estimating Markov-switching models with unknown and potentially non-normal error distributions. We approximate the unknown distribution of the error term by the Dirichlet process mixture of normals, in which the number of mixtures is treated as a parameter to estimate. In doing so, we pay a special attention to identification of the model. We apply the proposed model to the growth of post-war U.S. industrial production index in order to investigate its regime-switching dynamics. Our univariate model can effectively control for the irregular components that is not related to business conditions. This leads to sharp and accurate inferences on recession probabilities just like the dynamic factor models of Kim and Yoo (1995), Chauvet (1998), and Kim and Nelson (1998) do.

Key Words: Markov-switching, Dirichlet Process, Mixture of Normals, Business Cycle, Dynamic Factor Model.

¹ **Hwu:** Department of Economics, University of Washington, Seattle, WA 98195 [Email: hwus@uw.edu]; **Kim:** Department of Economics, University of Washington, Seattle, WA. 98195 [Email: changjin@uw.edu]. Kim acknowledges financial support from the Bryan C. Cressey Professorship at the University of Washington.