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Flexible Modeling of Time-Varying Parameters in Brand Choice Models: An Exploratory Approach

In most applications of brand choice models, estimated parameters representing brand preferences or consumers' sensitivities with regard to marketing variables (e.g., price and promotional activities) are assumed to be constant over time. However, marketing theories, as well as the experience of marketing practitioners, suggest the existence of trends and/or short-term variations in particular effects. We therefore develop flexible heterogeneous multinomial logit models to estimate time-varying effects. Both time-varying brand intercepts and time-varying effects of covariates are modeled based on penalized splines, a flexible yet parsimonious nonparametric smoothing technique. The estimation procedure is fully data-driven, determining the flexible function estimates and the corresponding degree of smoothness in a unified approach. The model accounts for parameter dynamics in a flexible way without any prior knowledge needed (how specific parameters might evolve) by the analyst or decision maker. In addition to functional flexibility, the model framework allows for heterogeneity in all parameters by additively decomposing parameter variation into time variation (at the population level) and cross-sectional heterogeneity (at the individual household level) and further nests random walk parameter evolutions used in recent state-space models.

For model comparison, we use several measures to evaluate in-sample fit as well as out-of-sample predictive performance. The results suggest that models considering parameter dynamics *and* household heterogeneity outperform less complex models (without heterogeneity and/or parameter dynamics) in terms of fit and predictive validity. Although models with random walk parameter evolutions imposed on both brand intercepts and covariate effects perform well, the proposed semiparametric approach provides a still higher predictive validity for two of the three data sets analyzed.

Overall, the proposed approach can uncover interesting and managerially relevant parameter paths from the data without imposing any prior assumptions on their shape and smoothness. Ignoring time-varying parameters might otherwise lead to biased inferences and therefore probably to wrong managerial insights and related retailing decisions. Optionally, estimated parameter paths could be linked in a second and unrelated step to further covariates to understand what drives changes in consumer choice behavior.