Fixed Bandwidth Asymptotics for Regression Discontinuity Designs*†

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Abstract

This paper analyzes the asymptotic distribution of local polynomial estimators in the context of regression discontinuity designs. The standard "small-h" approach in the literature (Hahn Todd and van der Klaauw 2001, Porter 2003, Imbens and Lemieux 2008 and Lee and Lemieux 2009) is to assume the bandwidth, $h$, around the discontinuity shrinks towards zero as the sample size increases. However, in practice, the researcher has to choose an $h > 0$ to implement the estimator. This paper derives the fixed-$h$ asymptotic distribution that allows for the bandwidth to be positive, providing refined approximations for the estimator’s behavior. When $h > 0$, the small-$h$ asymptotic variance is equivalent to assuming that the density of the running variable and the conditional variance of the dependent variable are constant around the cutoff. Simulations provide evidence that fixed-$h$ asymptotic distributions better describe the behavior of both bias and variance of the estimator, leading to improved inference. Estimators for fixed-$h$ standard errors are proposed and incorporate the theoretical gains of the improved approximations. The fixed-$h$ variance estimators improve markedly over small-$h$ estimators in the presence of some forms of heteroskedasticity. Interestingly, in the special case of homoskedastic errors using a local linear estimator, the variance estimators based on small-$h$ asymptotics produce tests with similar size to the fixed-$h$ variance estimators proposed in this paper.

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