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Boundedly pivotal structural change tests in continuous updating GMM with strong, weak identification and completely unidentified cases

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Abstract

This paper develops structural change tests in the continuous updating GMM framework that are robust to weak identification. We propose likelihood ratio-like, Anderson–Rubin [1949. Estimation of the parameters of a single equation in a complete system of stochastic equations. Annals of Mathematical Statistics 20, 46–63], and Kleinbergen [2005. Testing parameters in GMM without assuming that they are identified. Manuscript. Brown University] types of tests. Since the limits of the test statistics are not nuisance parameter free, bounds for the limit of the test statistics are derived. The bounds are nuisance parameter free and robust to identification problems. Simulations show that the Anderson–Rubin (1949) and Kleinbergen [2005. Testing parameters in GMM without assuming that they are identified. Manuscript. Brown University] type of tests have very good small sample properties. In the case of weak instruments, the sup LM test of Andrews [1993a. Tests for parameter instability and structural change with unknown change point. Econometrica 61, 821–856] rejects the true null of parameter stability more than the nominal level, and, also has low power in the weak instrument setup.

JEL classification: C13; C30

Keywords: Sequential empirical process; Constrained CUE; Weak instruments; Stability

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1. Introduction

In the econometrics literature, one possible source of the poor approximation of asymptotic normality to the finite sample behavior of GMM estimates and test statistics is the low correlation of the instruments with the first order conditions. Recently, in a seminal paper, Stock and Wright (2000) develop weak instrument asymptotics for GMM estimators and show that the new limits provide a better approximation for the finite sample behavior of estimators. They also provide a new test statistic, which is called the S-test. The S-test is the continuous updating GMM objective function evaluated at the restriction imposed by the null. Kleibergen (2005) provides an LM-like test statistic. This test has more power than the test statistic of Stock and Wright (2000).

Many researchers in economics and finance are interested in detecting regime changes. Andrews (1993a), in path-breaking work, considers structural change tests with an unknown change point in the standard two-step GMM setup. Andrews (1993a) develops the limit theory for the structural change test based on an LM-like test and a likelihood ratio-like test. However, these tests are derived under the assumption that all of the parameters are identified. We want to learn whether the large sample distributions of the structural change tests can provide good finite sample approximations when there are weak instruments in the system. We also want to derive structural change tests that are robust to identification problems.

In this paper, we suggest three test statistics to test the null of no regime change against an unknown change point. These are likelihood ratio-like, Anderson–Rubin (1949), and Kleibergen (2005) types of tests. Under certain cases of weak identification, and a completely unidentified case, Caner (2003) shows that the test statistics are not asymptotically pivotal. However, in this paper we show that the limits are bounded by a distribution. This asymptotic bound is robust to identification problems and nuisance parameter free. In GMM with weak instruments, tests for structural change amount to subvector testing. In those cases, we benefit from asymptotically conservative methods.

We also derive the limits for test statistics under only strong identification (standard GMM). To do that, we benefit from a result that we derive for sequential empirical processes. This result extends the iid sequential empirical process limit theorem in Van Der Vaart and Wellner (1996) to time series case. Next, we compare the limit bound in robust case to the limits that are derived in strong identification case. This can help us in assessing the magnitude of the mistake we may be encountering in the case of standard identification.

We conduct some simulations to understand the small sample behavior of the test statistics when the instruments are weakly correlated with the first order conditions. We show that Anderson–Rubin (1949) and Kleibergen (2005) types of tests are only slightly conservative, and have very good small sample properties. We also show that the sup LM test of Andrews (1993a), which is widely used in the literature, rejects the true null of stability much more often than the prescribed nominal level, and also, has low power.

Section 2 introduces the model, main assumptions, and an important result for sequential empirical processes. Section 3 introduces test statistics, and derives the distribution for the asymptotic bound. Section 4 conducts simulations. Section 5 concludes. The Appendix covers the main proofs and the limit theory for the restricted partial sample estimator and the limits of the test statistics proposed. The technical appendix contains some of the basic but tedious proofs. Let Θ denote a compact