Kernel-based Testing with Skewed and Heavy-tailed Data: Evidence from a Nonparametric Test for Heteroskedasticity

Supplementary Material

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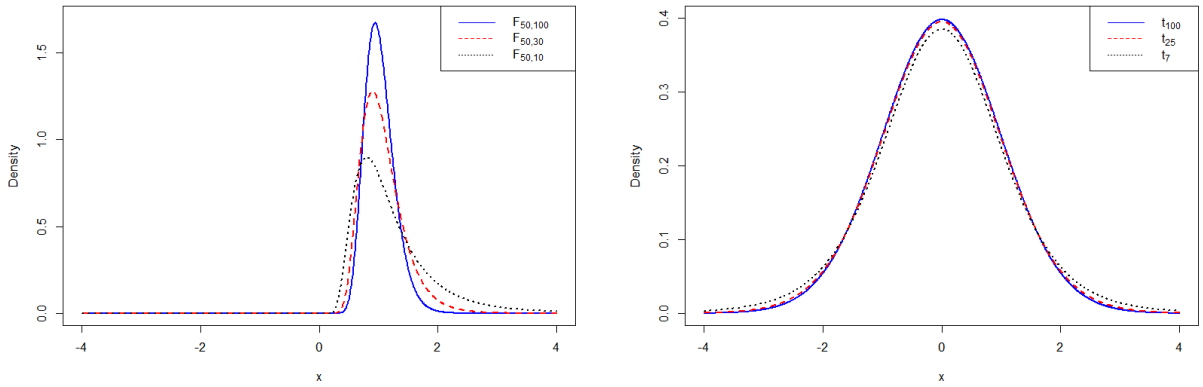
Appendix A



(a) F-distributions (b) t-distributions

Figure A1: Density plots of skewed and heavy-tailed data distributions

Appendix B

When errors are heavy-tailed, there are size improvements for almost all simulated regressors and sample sizes when we use the modified test. These results, for DGP2, with no trimming are available in Table B1 while Table B2 presents the results trimming the extreme 5% of the sample. In addition to being more favorable to the alternative test, size is also closer to the nominal value and can be improved further by trimming and using a smaller bandwidth.

The corresponding power results (DGP4 and DGP6) are available in Tables B7-B10 and Tables B15-B18, respectively. We note a slight loss of power when using the modified test as compared to the original Zheng (2009) test when looking at DGP4, which has conditional heteroskedasticity of a nonlinear form. In contrast, for DGP6 where the conditional heteroskedasticity is of a linear form, there are small gains in power when the regressors are skewed, but these gain diminish quickly as sample size increases. We also note that for some of these skewed regressors, both tests have low power, but as sample size increases, power approaches one and thus they are consistent tests. Results are similar for both levels of conditional heteroskedasticity.

Power results when the errors are normally distributed are similar and are available in Tables B3-B6 for DGP3 and Tables B11-14 for DGP5. For DGP3, there is a slight loss of power for skewed regressors when using the modified test as compared to the original Zheng (2009) test, while there is a slight gain for regressors that are fat-tailed. For DGP5, there is a slightly better power using the modified test for all distributions, but this quickly diminishes with sample size and then we note a slight loss of power using the modified test. Again, results are similar across the two levels of conditional heteroskedasticity.

Table B1: Size at the 5% level for DGP2 without trimming

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.011	0.018	0.016	0.012	0.015	0.016	0.010	0.006	0.021	0.019	0.017	0.014	0.013	0.018
	$\widehat{T}_A$		0.041	0.040	0.046	0.043	0.045	0.052	0.038	0.037	0.044	0.048	0.046	0.041	0.047	0.042
	$\widehat{T}_Z$	2.33	0.004	0.017	0.005	0.005	0.003	0.002	0.008	0.028	0.013	0.017	0.017	0.022	0.037	0.052
	$\widehat{T}_A$		0.022	0.057	0.032	0.019	0.031	0.034	0.033	0.062	0.073	0.057	0.076	0.078	0.096	0.118
200	$\widehat{T}_Z$	1	0.013	0.020	0.013	0.013	0.017	0.009	0.010	0.012	0.020	0.018	0.018	0.016	0.014	0.015
	$\widehat{T}_A$		0.031	0.036	0.046	0.043	0.030	0.029	0.033	0.030	0.033	0.038	0.039	0.037	0.020	0.030
	$\widehat{T}_Z$	2.33	0.010	0.006	0.008	0.006	0.008	0.005	0.005	0.013	0.020	0.012	0.024	0.020	0.017	0.041
	$\widehat{T}_A$		0.022	0.028	0.037	0.039	0.025	0.022	0.029	0.038	0.061	0.050	0.052	0.063	0.062	0.073
400	$\widehat{T}_Z$	1	0.019	0.018	0.021	0.012	0.015	0.011	0.013	0.010	0.018	0.021	0.017	0.020	0.017	0.016
	$\widehat{T}_A$		0.026	0.023	0.034	0.025	0.034	0.023	0.037	0.030	0.029	0.027	0.035	0.039	0.020	0.030
	$\widehat{T}_Z$	2.33	0.003	0.008	0.005	0.007	0.005	0.005	0.011	0.014	0.015	0.012	0.013	0.017	0.018	0.024
	$\widehat{T}_A$		0.013	0.029	0.022	0.025	0.026	0.018	0.025	0.047	0.044	0.047	0.041	0.051	0.055	0.057
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B2: Size at the 5% level for DGP2 with trimming 5% of the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.019	0.021	0.016	0.017	0.017	0.024	0.016	0.006	0.015	0.018	0.018	0.018	0.026	0.017
	$\widehat{T}_A$		0.047	0.043	0.050	0.050	0.046	0.050	0.060	0.036	0.038	0.054	0.060	0.043	0.059	0.057
	$\widehat{T}_Z$	2.33	0.008	0.013	0.008	0.007	0.006	0.003	0.007	0.013	0.015	0.012	0.009	0.013	0.008	0.012
	$\widehat{T}_A$		0.023	0.053	0.034	0.044	0.044	0.032	0.041	0.047	0.056	0.057	0.057	0.057	0.054	0.066
200	$\widehat{T}_Z$	1	0.021	0.021	0.022	0.015	0.022	0.019	0.017	0.015	0.018	0.016	0.019	0.029	0.022	0.020
	$\widehat{T}_A$		0.031	0.056	0.052	0.051	0.058	0.033	0.041	0.045	0.050	0.057	0.042	0.049	0.043	0.051
	$\widehat{T}_Z$	2.33	0.003	0.009	0.007	0.011	0.007	0.003	0.007	0.011	0.007	0.009	0.015	0.011	0.014	0.019
	$\widehat{T}_A$		0.015	0.038	0.035	0.043	0.031	0.034	0.032	0.045	0.046	0.043	0.053	0.043	0.060	0.055
400	$\widehat{T}_Z$	1	0.013	0.018	0.014	0.015	0.024	0.023	0.014	0.017	0.019	0.025	0.020	0.013	0.025	0.022
	$\widehat{T}_A$		0.021	0.035	0.028	0.048	0.043	0.040	0.045	0.035	0.031	0.051	0.037	0.033	0.043	0.044
	$\widehat{T}_Z$	2.33	0.014	0.007	0.010	0.007	0.012	0.009	0.007	0.004	0.018	0.009	0.009	0.012	0.014	0.017
	$\widehat{T}_A$		0.017	0.033	0.036	0.032	0.028	0.018	0.022	0.033	0.052	0.034	0.026	0.034	0.041	0.044
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B3: Power at the 5% level for DGP3 when $\lambda = 1.151$ and without trimming the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.416	0.792	0.284	0.426	0.608	0.755	0.884	0.972	0.964	0.947	0.960	0.961	0.964	0.963
	$\widehat{T}_A$		0.394	0.571	0.218	0.372	0.549	0.725	0.870	0.981	0.994	0.993	0.996	0.995	0.995	0.998
	$\widehat{T}_Z$	2.33	0.415	0.908	0.393	0.574	0.760	0.916	0.961	0.992	0.995	0.997	0.999	0.996	0.998	0.998
	$\widehat{T}_A$		0.548	0.703	0.310	0.468	0.680	0.872	0.944	0.993	0.999	0.999	1.000	1.000	1.000	1.000
200	$\widehat{T}_Z$	1	0.875	0.993	0.686	0.845	0.955	0.990	0.999	0.996	0.998	0.995	0.994	0.997	0.993	0.986
	$\widehat{T}_A$		0.760	0.851	0.432	0.640	0.840	0.966	0.996	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	0.905	1.000	0.862	0.958	0.993	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		0.892	0.947	0.572	0.788	0.940	0.994	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
400	$\widehat{T}_Z$	1	0.997	1.000	0.975	0.999	1.000	0.999	1.000	0.996	1.000	1.000	0.999	1.000	0.996	0.996
	$\widehat{T}_A$		0.980	0.982	0.716	0.925	0.993	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	0.998	1.000	0.994	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		0.998	1.000	0.885	0.984	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B4: Power at the 5% level for DGP3 when $\lambda = 1.151$ and with trimming 5% of the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.322	0.754	0.215	0.337	0.473	0.666	0.781	0.926	0.933	0.947	0.943	0.956	0.947	0.962
	$\widehat{T}_A$		0.328	0.537	0.175	0.285	0.433	0.607	0.743	0.940	0.972	0.978	0.968	0.984	0.978	0.990
	$\widehat{T}_Z$	2.33	0.288	0.856	0.294	0.424	0.608	0.781	0.893	0.973	0.978	0.976	0.989	0.983	0.993	0.989
	$\widehat{T}_A$		0.464	0.607	0.182	0.319	0.520	0.710	0.835	0.952	0.996	0.994	0.998	1.000	0.999	1.000
200	$\widehat{T}_Z$	1	0.768	0.989	0.564	0.722	0.903	0.972	0.990	0.999	0.998	0.999	1.000	0.999	1.000	0.999
	$\widehat{T}_A$		0.657	0.814	0.290	0.468	0.688	0.866	0.946	0.999	1.000	0.999	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	0.801	0.998	0.687	0.866	0.962	0.991	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000
	$\widehat{T}_A$		0.808	0.905	0.338	0.558	0.807	0.958	0.985	0.998	1.000	1.000	1.000	1.000	1.000	1.000
400	$\widehat{T}_Z$	1	0.991	1.000	0.939	0.987	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		0.956	0.979	0.565	0.780	0.945	0.993	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	0.995	1.000	0.977	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		0.992	0.996	0.692	0.901	0.983	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B5: Power at the 5% level for DGP3 when $\lambda = 4.530$ and without trimming the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.962	0.955	0.642	0.797	0.911	0.951	0.973	0.981	0.981	0.983	0.978	0.978	0.972	0.976
	$\widehat{T}_A$		0.892	0.852	0.504	0.693	0.833	0.944	0.975	0.998	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	0.971	0.995	0.797	0.902	0.974	0.997	0.999	0.999	1.000	0.999	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		0.975	0.906	0.625	0.774	0.929	0.982	0.993	1.000	1.000	1.000	1.000	1.000	1.000	1.000
200	$\widehat{T}_Z$	1	1.000	0.999	0.971	0.990	0.996	0.998	0.997	0.998	0.996	0.998	0.996	0.993	0.991	0.989
	$\widehat{T}_A$		0.998	0.981	0.782	0.933	0.991	0.997	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	1.000	1.000	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000
	$\widehat{T}_A$		1.000	0.996	0.896	0.974	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
400	$\widehat{T}_Z$	1	1.000	1.000	1.000	1.000	1.000	0.999	0.998	0.992	0.999	0.999	0.999	0.997	0.997	0.992
	$\widehat{T}_A$		1.000	1.000	0.979	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B6: Power at the 5% level for DGP3 when $\lambda = 4.530$ and with trimming 5% of the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.930	0.926	0.513	0.699	0.817	0.909	0.961	0.985	0.991	0.993	0.994	0.983	0.986	0.977
	$\widehat{T}_A$		0.853	0.790	0.391	0.578	0.744	0.860	0.950	0.990	1.000	0.998	1.000	0.998	0.999	1.000
	$\widehat{T}_Z$	2.33	0.948	0.982	0.636	0.810	0.931	0.972	0.995	0.995	1.000	1.000	1.000	1.000	0.998	1.000
	$\widehat{T}_A$		0.962	0.883	0.457	0.633	0.834	0.934	0.975	0.993	1.000	1.000	1.000	1.000	1.000	1.000
200	$\widehat{T}_Z$	1	1.000	0.998	0.929	0.981	0.997	0.997	0.999	1.000	1.000	1.000	0.999	0.998	1.000	0.999
	$\widehat{T}_A$		0.991	0.958	0.656	0.826	0.951	0.990	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	1.000	1.000	0.974	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	0.993	0.750	0.913	0.983	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
400	$\widehat{T}_Z$	1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	1.000	0.925	0.973	0.998	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	1.000	0.978	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B7: Power at the 5% level for DGP4 when $\lambda = 1.151$ and without trimming the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.980	0.262	0.062	0.087	0.119	0.154	0.257	0.421	0.977	0.982	0.978	0.986	0.984	0.987
	$\widehat{T}_A$		0.883	0.131	0.060	0.087	0.127	0.154	0.254	0.429	0.879	0.898	0.877	0.897	0.898	0.883
	$\widehat{T}_Z$	2.33	0.998	0.309	0.070	0.097	0.156	0.236	0.317	0.515	0.998	1.000	0.998	0.998	0.995	0.998
	$\widehat{T}_A$		0.932	0.128	0.060	0.093	0.124	0.196	0.304	0.505	0.953	0.951	0.963	0.961	0.959	0.975
200	$\widehat{T}_Z$	1	1.000	0.604	0.122	0.202	0.284	0.440	0.579	0.844	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		0.997	0.226	0.078	0.131	0.188	0.302	0.446	0.732	0.985	0.988	0.987	0.993	0.989	0.987
	$\widehat{T}_Z$	2.33	1.000	0.791	0.167	0.285	0.469	0.589	0.758	0.914	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		0.998	0.269	0.081	0.165	0.285	0.416	0.596	0.831	0.999	1.000	1.000	1.000	1.000	1.000
400	$\widehat{T}_Z$	1	1.000	0.967	0.301	0.476	0.694	0.872	0.964	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	0.438	0.109	0.211	0.395	0.595	0.801	0.975	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	1.000	0.989	0.464	0.658	0.848	0.959	0.988	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	0.581	0.188	0.307	0.527	0.795	0.923	0.992	1.000	1.000	1.000	1.000	1.000	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B8: Power at the 5% level for DGP4 when $\lambda = 1.151$ and with trimming 5% of the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.969	0.227	0.055	0.074	0.103	0.135	0.167	0.297	0.962	0.981	0.982	0.970	0.975	0.974
	$\widehat{T}_A$		0.850	0.124	0.056	0.067	0.095	0.141	0.192	0.317	0.845	0.848	0.865	0.848	0.853	0.864
	$\widehat{T}_Z$	2.33	0.988	0.254	0.043	0.081	0.123	0.168	0.219	0.435	0.997	0.994	0.997	0.993	0.997	0.998
	$\widehat{T}_A$		0.899	0.123	0.042	0.065	0.110	0.154	0.217	0.418	0.935	0.927	0.922	0.932	0.949	0.948
200	$\widehat{T}_Z$	1	1.000	0.539	0.109	0.144	0.246	0.358	0.477	0.685	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		0.993	0.200	0.079	0.109	0.152	0.244	0.348	0.559	0.990	0.976	0.981	0.977	0.981	0.979
	$\widehat{T}_Z$	2.33	1.000	0.699	0.125	0.188	0.303	0.451	0.608	0.816	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	0.243	0.055	0.098	0.159	0.271	0.449	0.669	0.999	0.998	0.995	0.999	0.998	0.998
400	$\widehat{T}_Z$	1	1.000	0.939	0.258	0.402	0.518	0.728	0.869	0.972	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	0.398	0.106	0.172	0.244	0.442	0.642	0.877	1.000	0.999	1.000	0.999	1.000	1.000
	$\widehat{T}_Z$	2.33	1.000	0.984	0.401	0.546	0.722	0.875	0.948	0.995	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	0.534	0.141	0.226	0.338	0.537	0.747	0.936	1.000	1.000	1.000	1.000	1.000	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B9: Power at the 5% level for DGP4 when $\lambda = 4.530$ and without trimming the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.977	0.560	0.147	0.206	0.304	0.460	0.588	0.780	0.996	0.995	0.993	0.992	0.996	0.991
	$\widehat{T}_A$		0.910	0.291	0.106	0.164	0.277	0.402	0.548	0.740	0.994	0.988	0.983	0.994	0.992	0.995
	$\widehat{T}_Z$	2.33	0.993	0.710	0.189	0.291	0.416	0.563	0.705	0.859	0.999	0.999	0.997	0.999	1.000	1.000
	$\widehat{T}_A$		0.980	0.311	0.116	0.209	0.327	0.447	0.599	0.791	1.000	1.000	0.999	0.999	1.000	1.000
200	$\widehat{T}_Z$	1	1.000	0.946	0.352	0.543	0.704	0.890	0.951	0.995	1.000	1.000	1.000	1.000	0.998	1.000
	$\widehat{T}_A$		0.999	0.525	0.181	0.319	0.466	0.712	0.829	0.966	0.999	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	1.000	0.988	0.532	0.688	0.871	0.951	0.981	0.998	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	0.652	0.230	0.375	0.623	0.821	0.905	0.988	1.000	1.000	1.000	1.000	1.000	1.000
400	$\widehat{T}_Z$	1	1.000	1.000	0.800	0.933	0.985	0.997	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	0.808	0.355	0.582	0.824	0.959	0.991	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	1.000	1.000	0.899	0.972	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	0.953	0.471	0.754	0.910	0.990	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B10: Power at the 5% level for DGP4 when $\lambda = 4.530$ and with trimming 5% of the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.970	0.499	0.112	0.170	0.236	0.357	0.439	0.663	0.983	0.992	0.988	0.988	0.995	0.990
	$\widehat{T}_A$		0.915	0.276	0.098	0.147	0.207	0.337	0.425	0.633	0.980	0.981	0.978	0.989	0.983	0.990
	$\widehat{T}_Z$	2.33	0.993	0.653	0.146	0.217	0.341	0.444	0.580	0.781	1.000	0.997	0.996	0.997	1.000	0.997
	$\widehat{T}_A$		0.983	0.305	0.097	0.140	0.263	0.342	0.485	0.725	1.000	0.999	0.997	0.999	0.998	0.998
200	$\widehat{T}_Z$	1	1.000	0.928	0.315	0.420	0.577	0.790	0.878	0.971	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		0.998	0.513	0.156	0.219	0.362	0.575	0.732	0.911	1.000	1.000	1.000	0.999	1.000	0.999
	$\widehat{T}_Z$	2.33	1.000	0.982	0.434	0.574	0.753	0.877	0.945	0.996	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	0.615	0.190	0.276	0.450	0.646	0.793	0.954	1.000	1.000	1.000	1.000	1.000	1.000
400	$\widehat{T}_Z$	1	1.000	1.000	0.703	0.854	0.958	0.994	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	0.810	0.283	0.446	0.650	0.843	0.946	0.996	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	1.000	1.000	0.837	0.943	0.988	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		1.000	0.932	0.380	0.544	0.788	0.927	0.987	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B11: Power at the 5% level for DGP5 when $\lambda = 1.151$ and without trimming the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.196	0.541	0.170	0.263	0.395	0.541	0.697	0.859	0.855	0.851	0.887	0.878	0.893	0.909
	$\widehat{T}_A$		0.291	0.460	0.230	0.317	0.459	0.603	0.746	0.906	0.939	0.932	0.940	0.951	0.958	0.967
	$\widehat{T}_Z$	2.33	0.142	0.651	0.199	0.326	0.484	0.656	0.786	0.930	0.934	0.949	0.935	0.953	0.965	0.976
	$\widehat{T}_A$		0.334	0.502	0.223	0.341	0.502	0.655	0.804	0.933	0.980	0.980	0.985	0.988	0.985	0.996
200	$\widehat{T}_Z$	1	0.471	0.885	0.333	0.529	0.716	0.879	0.942	0.981	0.982	0.982	0.974	0.985	0.985	0.985
	$\widehat{T}_A$		0.469	0.644	0.301	0.471	0.651	0.847	0.921	0.989	0.991	0.993	0.991	0.996	0.997	0.998
	$\widehat{T}_Z$	2.33	0.434	0.932	0.485	0.662	0.825	0.935	0.972	0.996	0.999	0.996	0.997	0.999	0.997	0.998
	$\widehat{T}_A$		0.554	0.745	0.377	0.528	0.733	0.880	0.955	0.995	0.999	0.998	0.999	0.998	0.998	0.999
400	$\widehat{T}_Z$	1	0.832	0.986	0.699	0.845	0.952	0.988	0.992	0.998	0.997	0.998	0.996	0.994	0.996	0.991
	$\widehat{T}_A$		0.763	0.853	0.476	0.680	0.858	0.971	0.989	0.998	0.999	0.999	0.998	0.999	0.999	1.000
	$\widehat{T}_Z$	2.33	0.849	0.992	0.766	0.915	0.973	0.997	0.995	0.999	1.000	1.000	1.000	0.999	1.000	1.000
	$\widehat{T}_A$		0.834	0.901	0.555	0.773	0.915	0.983	0.995	1.000	1.000	1.000	1.000	0.999	1.000	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B12: Power at the 5% level for DGP5 when $\lambda = 1.151$ and with trimming 5% of the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.155	0.463	0.119	0.197	0.263	0.419	0.534	0.766	0.770	0.785	0.806	0.789	0.862	0.868
	$\widehat{T}_A$		0.237	0.381	0.182	0.270	0.345	0.484	0.597	0.802	0.876	0.885	0.910	0.890	0.925	0.941
	$\widehat{T}_Z$	2.33	0.142	0.550	0.125	0.239	0.344	0.497	0.635	0.823	0.847	0.836	0.876	0.876	0.875	0.926
	$\widehat{T}_A$		0.308	0.425	0.160	0.262	0.382	0.534	0.638	0.838	0.946	0.935	0.961	0.962	0.961	0.976
200	$\widehat{T}_Z$	1	0.365	0.814	0.242	0.387	0.579	0.733	0.859	0.959	0.968	0.976	0.977	0.982	0.983	0.983
	$\widehat{T}_A$		0.379	0.566	0.226	0.345	0.521	0.662	0.827	0.944	0.980	0.981	0.985	0.989	0.990	0.994
	$\widehat{T}_Z$	2.33	0.370	0.883	0.339	0.470	0.682	0.811	0.920	0.981	0.991	0.980	0.989	0.991	0.991	0.999
	$\widehat{T}_A$		0.500	0.635	0.252	0.371	0.565	0.719	0.853	0.961	0.996	0.985	0.992	0.996	0.995	0.998
400	$\widehat{T}_Z$	1	0.726	0.983	0.539	0.722	0.860	0.964	0.984	0.998	0.998	0.996	0.997	0.999	0.998	1.000
	$\widehat{T}_A$		0.669	0.816	0.325	0.472	0.696	0.876	0.947	0.992	0.998	0.998	0.996	0.999	0.999	1.000
	$\widehat{T}_Z$	2.33	0.753	0.989	0.664	0.828	0.911	0.982	0.990	0.999	0.998	0.998	0.998	0.999	1.000	1.000
	$\widehat{T}_A$		0.749	0.857	0.389	0.575	0.757	0.902	0.972	0.996	0.995	0.998	0.996	0.999	1.000	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B13: Power at the 5% level for DGP5 when $\lambda = 4.530$ and without trimming the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.788	0.807	0.375	0.513	0.681	0.812	0.882	0.959	0.959	0.965	0.965	0.963	0.962	0.946
	$\widehat{T}_A$		0.743	0.674	0.400	0.531	0.697	0.816	0.908	0.976	0.995	0.997	0.999	0.997	0.998	0.997
	$\widehat{T}_Z$	2.33	0.794	0.880	0.500	0.661	0.822	0.901	0.957	0.989	0.992	0.995	0.997	0.995	0.994	0.991
	$\widehat{T}_A$		0.899	0.734	0.438	0.614	0.784	0.878	0.943	0.988	0.999	1.000	1.000	0.999	1.000	1.000
200	$\widehat{T}_Z$	1	0.971	0.977	0.717	0.863	0.948	0.975	0.990	0.993	0.987	0.984	0.989	0.987	0.984	0.978
	$\widehat{T}_A$		0.937	0.875	0.569	0.756	0.902	0.961	0.982	0.999	0.999	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	0.988	0.990	0.832	0.935	0.970	0.992	0.996	1.000	0.999	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		0.981	0.915	0.647	0.827	0.930	0.985	0.993	1.000	1.000	1.000	1.000	1.000	1.000	1.000
400	$\widehat{T}_Z$	1	0.997	0.998	0.952	0.983	0.992	0.994	0.996	0.992	0.997	0.997	0.994	0.996	0.997	0.990
	$\widehat{T}_A$		0.988	0.971	0.789	0.924	0.982	0.997	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	0.997	0.997	0.979	0.994	0.998	0.998	0.999	1.000	1.000	1.000	1.000	1.000	0.999	1.000
	$\widehat{T}_A$		0.996	0.983	0.869	0.958	0.987	0.997	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B14: Power at the 5% level for DGP5 when $\lambda = 4.530$ and with trimming 5% of the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.733	0.754	0.319	0.436	0.572	0.715	0.828	0.917	0.963	0.958	0.965	0.967	0.969	0.953
	$\widehat{T}_A$		0.694	0.647	0.330	0.433	0.594	0.737	0.853	0.942	0.994	0.990	0.989	0.990	0.997	0.996
	$\widehat{T}_Z$	2.33	0.701	0.837	0.370	0.507	0.693	0.813	0.887	0.963	0.988	0.992	0.990	0.993	0.991	0.995
	$\widehat{T}_A$		0.841	0.693	0.338	0.466	0.645	0.782	0.875	0.970	0.996	0.998	0.996	0.999	0.998	0.999
200	$\widehat{T}_Z$	1	0.963	0.961	0.625	0.786	0.885	0.960	0.987	0.995	0.997	0.998	0.996	0.995	0.997	0.997
	$\widehat{T}_A$		0.912	0.806	0.477	0.627	0.791	0.914	0.959	0.994	0.999	0.999	0.999	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	0.960	0.977	0.740	0.838	0.934	0.976	0.990	0.998	1.000	0.999	1.000	0.999	0.998	1.000
	$\widehat{T}_A$		0.971	0.873	0.514	0.668	0.833	0.943	0.979	0.995	1.000	1.000	1.000	0.999	1.000	1.000
400	$\widehat{T}_Z$	1	0.999	0.997	0.910	0.966	0.989	0.999	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_A$		0.996	0.947	0.651	0.822	0.935	0.987	0.992	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	$\widehat{T}_Z$	2.33	0.998	0.996	0.957	0.974	0.993	0.996	0.999	1.000	1.000	1.000	1.000	1.000	0.999	1.000
	$\widehat{T}_A$		0.998	0.966	0.708	0.864	0.949	0.987	0.994	0.999	1.000	1.000	1.000	1.000	1.000	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B15: Power at the 5% level for DGP6 when $\lambda = 1.151$ and without trimming the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.836	0.106	0.041	0.046	0.068	0.110	0.147	0.276	0.858	0.874	0.882	0.885	0.878	0.890
	$\widehat{T}_A$		0.735	0.120	0.079	0.099	0.146	0.196	0.219	0.361	0.741	0.754	0.740	0.769	0.775	0.793
	$\widehat{T}_Z$	2.33	0.896	0.131	0.029	0.062	0.072	0.121	0.174	0.302	0.912	0.906	0.922	0.920	0.935	0.925
	$\widehat{T}_A$		0.774	0.115	0.061	0.116	0.126	0.168	0.252	0.369	0.806	0.818	0.834	0.834	0.850	0.865
200	$\widehat{T}_Z$	1	0.988	0.261	0.056	0.097	0.150	0.212	0.321	0.500	0.984	0.991	0.983	0.984	0.977	0.988
	$\widehat{T}_A$		0.937	0.159	0.100	0.120	0.202	0.261	0.355	0.524	0.917	0.908	0.918	0.912	0.916	0.942
	$\widehat{T}_Z$	2.33	0.983	0.354	0.067	0.121	0.202	0.298	0.412	0.593	0.988	0.991	0.989	0.993	0.993	0.993
	$\widehat{T}_A$		0.937	0.166	0.088	0.136	0.217	0.299	0.390	0.550	0.952	0.959	0.956	0.953	0.968	0.970
400	$\widehat{T}_Z$	1	0.996	0.584	0.136	0.207	0.325	0.474	0.632	0.828	0.999	0.996	0.996	0.997	1.000	0.998
	$\widehat{T}_A$		0.991	0.251	0.106	0.166	0.255	0.404	0.521	0.759	0.977	0.981	0.984	0.982	0.989	0.987
	$\widehat{T}_Z$	2.33	0.998	0.711	0.195	0.293	0.422	0.561	0.731	0.897	1.000	0.998	1.000	0.998	1.000	1.000
	$\widehat{T}_A$		0.994	0.282	0.145	0.199	0.293	0.431	0.593	0.819	0.995	0.992	0.996	0.992	0.999	0.998
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B16: Power at the 5% level for DGP6 when $\lambda = 1.151$ and with trimming 5% of the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.797	0.104	0.043	0.040	0.070	0.088	0.116	0.185	0.854	0.841	0.856	0.851	0.853	0.840
	$\widehat{T}_A$		0.682	0.127	0.090	0.095	0.135	0.167	0.209	0.317	0.733	0.726	0.708	0.732	0.732	0.743
	$\widehat{T}_Z$	2.33	0.850	0.118	0.030	0.031	0.063	0.097	0.129	0.205	0.911	0.902	0.904	0.903	0.904	0.917
	$\widehat{T}_A$		0.735	0.108	0.072	0.092	0.119	0.166	0.208	0.281	0.775	0.778	0.762	0.786	0.784	0.781
200	$\widehat{T}_Z$	1	0.967	0.260	0.055	0.078	0.123	0.175	0.226	0.403	0.982	0.979	0.982	0.983	0.981	0.975
	$\widehat{T}_A$		0.921	0.148	0.090	0.109	0.149	0.210	0.259	0.453	0.887	0.893	0.879	0.894	0.889	0.888
	$\widehat{T}_Z$	2.33	0.983	0.303	0.054	0.077	0.124	0.199	0.274	0.451	0.983	0.987	0.991	0.989	0.991	0.990
	$\widehat{T}_A$		0.926	0.164	0.093	0.091	0.145	0.215	0.309	0.438	0.941	0.933	0.925	0.943	0.951	0.943
400	$\widehat{T}_Z$	1	0.998	0.521	0.097	0.156	0.215	0.352	0.465	0.696	0.996	0.997	1.000	0.996	0.994	0.997
	$\widehat{T}_A$		0.991	0.214	0.095	0.143	0.181	0.329	0.410	0.640	0.975	0.981	0.974	0.975	0.983	0.982
	$\widehat{T}_Z$	2.33	0.998	0.629	0.125	0.209	0.286	0.462	0.578	0.776	0.998	0.998	0.998	1.000	0.998	1.000
	$\widehat{T}_A$		0.989	0.251	0.099	0.150	0.213	0.335	0.458	0.640	0.986	0.989	0.992	0.990	0.979	0.989
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B17: Power at the 5% level for DGP6 when $\lambda = 4.530$ and without trimming the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.840	0.318	0.090	0.127	0.141	0.260	0.354	0.541	0.951	0.937	0.951	0.945	0.963	0.948
	$\widehat{T}_A$		0.784	0.243	0.122	0.180	0.193	0.318	0.446	0.597	0.952	0.964	0.956	0.962	0.972	0.965
	$\widehat{T}_Z$	2.33	0.871	0.373	0.090	0.142	0.204	0.308	0.415	0.564	0.958	0.961	0.958	0.964	0.961	0.966
	$\widehat{T}_A$		0.878	0.230	0.117	0.177	0.259	0.341	0.459	0.577	0.980	0.984	0.982	0.986	0.986	0.984
200	$\widehat{T}_Z$	1	0.984	0.666	0.162	0.242	0.372	0.518	0.688	0.863	0.997	0.996	0.992	0.994	0.995	0.996
	$\widehat{T}_A$		0.965	0.338	0.164	0.233	0.330	0.448	0.646	0.822	0.998	0.993	0.994	0.993	0.994	0.995
	$\widehat{T}_Z$	2.33	0.984	0.730	0.226	0.351	0.482	0.638	0.755	0.898	0.999	0.998	0.998	0.997	0.998	0.999
	$\widehat{T}_A$		0.976	0.382	0.195	0.284	0.399	0.530	0.655	0.844	0.999	0.999	0.998	0.999	0.999	1.000
400	$\widehat{T}_Z$	1	0.998	0.926	0.377	0.520	0.713	0.851	0.940	0.986	0.999	0.997	1.000	0.999	1.000	0.998
	$\widehat{T}_A$		0.992	0.531	0.251	0.367	0.534	0.705	0.842	0.961	1.000	1.000	1.000	0.999	1.000	0.999
	$\widehat{T}_Z$	2.33	0.999	0.964	0.471	0.678	0.822	0.897	0.958	0.993	1.000	0.998	0.999	1.000	1.000	1.000
	$\widehat{T}_A$		0.998	0.633	0.271	0.461	0.596	0.783	0.880	0.972	1.000	0.999	0.999	1.000	0.999	1.000
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

Table B18: Power at the 5% level for DGP6 when $\lambda = 4.530$ and with trimming 5% of the data

n	Test	c	$U[-1,1]$	$\mathcal{N}(0,0.5)$	$F_{50,100}$	$F_{50,50}$	$F_{50,30}$	$F_{50,20}$	$F_{50,15}$	$F_{50,10}$	t_{100}	t_{50}	t_{25}	t_{15}	t_{10}	t_7
100	$\widehat{T}_Z$	1	0.833	0.257	0.082	0.121	0.132	0.207	0.255	0.430	0.923	0.938	0.935	0.941	0.940	0.941
	$\widehat{T}_A$		0.786	0.211	0.122	0.171	0.218	0.287	0.339	0.531	0.936	0.959	0.939	0.939	0.950	0.959
	$\widehat{T}_Z$	2.33	0.852	0.319	0.068	0.091	0.167	0.240	0.320	0.512	0.931	0.921	0.940	0.940	0.947	0.951
	$\widehat{T}_A$		0.861	0.217	0.095	0.130	0.202	0.309	0.367	0.551	0.955	0.963	0.972	0.966	0.971	0.978
200	$\widehat{T}_Z$	1	0.980	0.592	0.139	0.201	0.292	0.399	0.535	0.766	0.997	0.995	0.996	0.993	0.995	0.994
	$\widehat{T}_A$		0.942	0.329	0.122	0.207	0.276	0.392	0.521	0.717	0.996	0.987	0.991	0.988	0.989	0.992
	$\widehat{T}_Z$	2.33	0.985	0.678	0.155	0.204	0.361	0.522	0.656	0.818	0.995	0.992	0.996	0.996	0.999	0.992
	$\widehat{T}_A$		0.979	0.309	0.129	0.167	0.303	0.438	0.555	0.736	0.998	0.996	0.996	0.999	0.997	1.000
400	$\widehat{T}_Z$	1	0.997	0.897	0.269	0.430	0.584	0.722	0.868	0.959	0.999	1.000	0.999	0.998	1.000	0.998
	$\widehat{T}_A$		0.997	0.445	0.169	0.279	0.423	0.559	0.717	0.898	0.999	0.999	1.000	0.999	0.997	0.999
	$\widehat{T}_Z$	2.33	0.998	0.951	0.351	0.527	0.701	0.832	0.910	0.975	0.999	1.000	0.998	1.000	0.999	0.999
	$\widehat{T}_A$		0.997	0.565	0.190	0.301	0.456	0.635	0.773	0.918	1.000	1.000	0.998	1.000	0.999	0.999
	Skewness		0.00	0.00	0.68	0.92	1.23	1.64	2.10	3.47	0.00	0.00	0.00	0.00	0.00	0.00
	Excess kurtosis		-1.20	0.00	0.84	1.62	3.03	5.68	10.21	42.20	0.06	0.13	0.29	0.55	1.00	2.00

The $\widehat{T}_Z$ test is the nonparametric conditional moment test for heteroskedasticity from Zheng (2009); the $\widehat{T}_A$ test is the proposed alternative Zheng test. In all simulations, we use 1,000 simulated samples and 500 bootstrap replications with the skew-corrected wild bootstrap procedure are used to obtain the critical values. Both tests estimate the smooth conditional mean via local-constant least-squares using an Epanechnikov kernel.

References

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