Power and false negatives in Qualitative Comparative Analysis (QCA): Foundations, Simulation and Estimation for Empirical Studies

Appendix

Ingo Rohlfing*

Friday 14th July, 2017

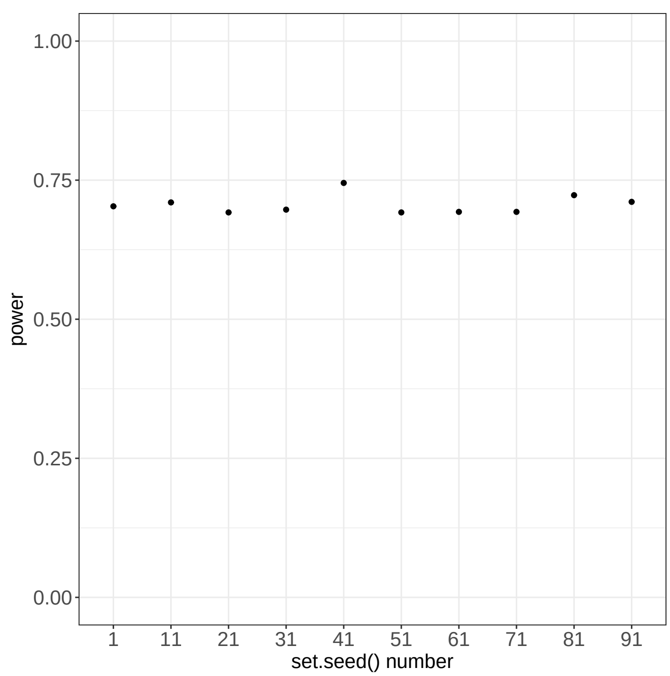
*Cologne Center for Comparative Politics, Universität zu Köln, i.rohlfing@uni-koeln.de

The appendix deepens the discussion of some issues addressed in the manuscript and presents robustness checks on the simulations summarized in figure 2 in the manuscript.

INDEPENDENCE OF POWER ESTIMATES FROM `SET.SEED()` NUMBER

The simulations are based on randomized permutation tests rather than exact tests. As a check as to whether power estimates are sensitive to different `set.seed()` numbers that ensure reproducibility in `R`, I estimated power for different numbers with otherwise identical parameters. Figure A.1 shows that the power estimates are in a reasonably narrow range and that the chosen `set.seed()` number does not matter for the results.

Figure A.1: Power estimates for different `set.seed()` numbers



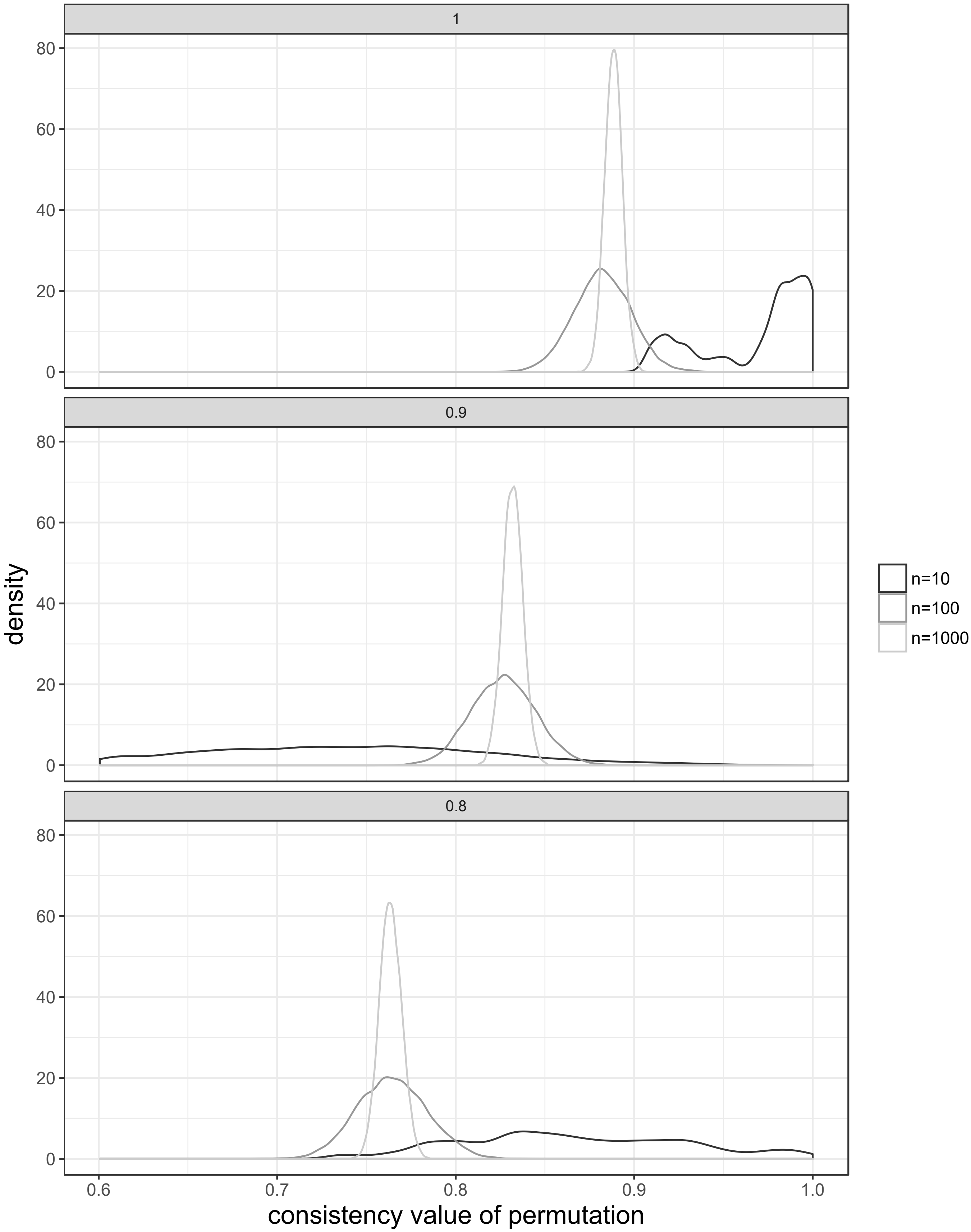
WHY POWER SOMETIMES CANNOT BE LARGE

Figure 2 and table 1 in the manuscript show that power can be high if the number of cases is sufficiently large. However, it is not always possible to achieve high power because it depends on the chosen values of c_{H1} and c_{H0}. If both values are high and, thus, the difference small, power is low regardless of the number of cases and is estimated to be the lower, the smaller the larger the number of cases. The reason for this rests in the calculation of the consistency value and the logic of estimating power by permuting a simulated dataset. If we simulate a dataset with a consistency value of 1, this means that every case membership in the term A is equal to or smaller than its membership value in Y. By permuting the data, it is likely that a case is assigned a membership score for Y that is smaller than membership in A and pushes the consistency value below 1. Because of this relationship between the consistency score and permutations, the permuted consistency values are most often below 1 and yield a distribution that is located somewhere in the upper range of the spectrum of consistency scores. The larger the number of cases, the narrower the distribution and the less likely it is that c_{H0} is located in its lower 5%-quantile. This can already be inferred from figure 5 in the manuscript and might become more obvious in figure A.2.

In figure A.2 that plots three distributions with a different number of cases per value of c_{H1}, we can see why it can be impossible to achieve a sufficiently high level of power. In a sense, the figure is an extension of figure 4 in the manuscript, which illustrates why power decreases as n increases, because it raises n beyond 50. For an n of 100 and 1000, the distribution achieves its median around a value of 0.88 and becomes narrow. For c_{H1}=1, a value of 0.95 for c_{H0} then falls into the far right tail of the distribution. It achieves statistic significance, but this is meaningless for power analysis because the test for significance is left-sided.

The top panel in figure A.2 shows that more cases don't help in increasing power, but

Figure A.2: Illustrative distributions of consistency values for three values of c_{H1}

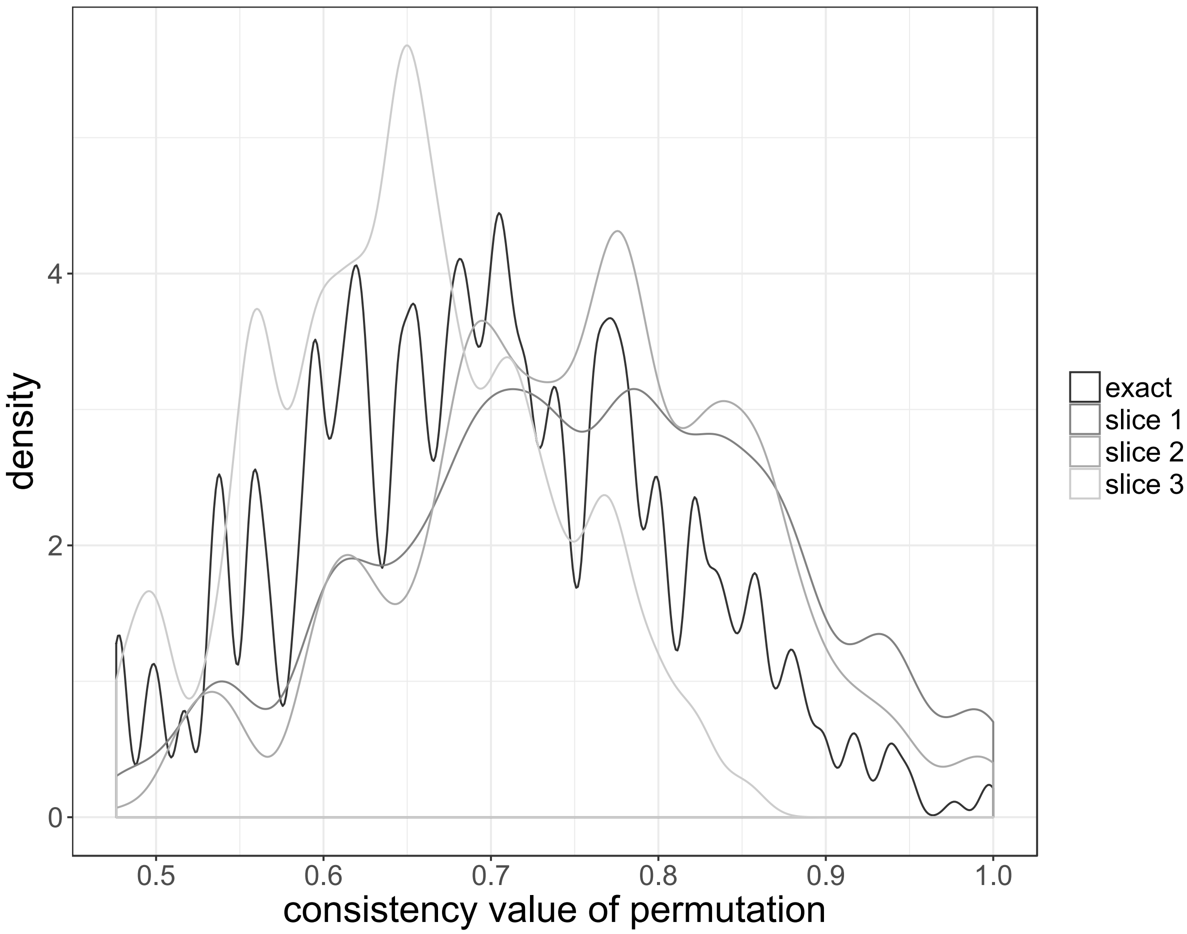


achieve the contrary by narrowing the distribution and making it increasingly unlikely that a value of 0.95 for c_{H0} is significant. This changes as we lower the value of c_{H1} to 0.9 and 0.8. If we keep the difference to c_{H0} fixed, we see in the middle panel for c_{H0}=0.85 that it is still located in the right tail, but less so than for c_{H0}=0.95 in the top panel. In the lower panel, we achieve statistical significance if we set c_{H0} to 0.75. We are only looking at one permuted distribution here, but figure A.2 and table 1 in the manuscript show that, although the difference between c_{H1} and c_{H0} is only 0.05 points in the lower panel, it is now possible to increase power by raising n further and further.

EXACT PERMUTATION TESTS AND THE CONSISTENCY VALUE DISTRIBUTION

In section 5.2 in the manuscript, I show that the permuted distributions of consistency values differ strongly from each other if the number of cases is ten. The variability of the distributions is not an artifact of generating 10000 permutations, which is a small number compared to the 3628800 permutations needed for an exact permutation test. Figure A.3 presents one exact distribution for a simulated dataset comprising 10 cases. It shows that the distribution is also wide for an exact test and that the problem of variability is not associated with the number of permutations. This is indicated by the three other distributions in figure A.3 each of which is based on an arbitrary slice of 10000 permutations of the full data. The 5%-quantiles of the four distributions are close to each other with 0.53 for the exact distribution and 0.54, 0.56 and 0.5 for the three randomized permutations.

Figure A.3: Exact distribution of consistency values for 10 cases



ARTICLES USED FOR *EX POST* POWER ANALYSIS

Adhikari, Prakash, and Steven Samford. 2013. The Nepali State and the dynamics of the Maoist insurgency. *Studies in Comparative International Development* 48(4):457-81.

Bank, André, Thomas Richter, and Anna Sunik. 2015. Long-term monarchical survival in the Middle East: A configurational comparison, 1945-2012. *Democratization* 22(1):179-200.

Beck, Colin J. 2014. Reflections on the revolutionary wave in 2011. *Theory and Society* 43(2):197-223.

Bentele, Keith Gunnar. 2013. Distinct paths to higher inequality? A Qualitative Comparative Analysis of rising earnings inequality among US States, 1980-2010. *Research in Social Stratification and Mobility* 34:30-57.

Binder, Martin. 2015. Paths to intervention: What explains the UN's selective response to humanitarian crises? *Journal of Peace Research* 52(6):712-26.

Boon, Jan, and Koen Verhoest. 2014. On a diet: Differences in overhead among public agencies in the era of austerity. *Public Performance & Management Review* 38(2):234-60.

Bretthauer, Judith M. 2015. Conditions for peace and conflict: Applying a fuzzy-set Qualitative Comparative Analysis to cases of resource scarcity. *Journal of Conflict Resolution* 59(4):593-616.

Cacciatore, Federica, Alessandro Natalini, and Claudius Wagemann. 2015. Clustered Europeanization and national reform programmes: A Qualitative Comparative Analysis. *Journal of European Public Policy* 22(8):1186-1211.

Cebotari, Victor, and Maarten P. Vink. 2013. A configurational analysis of ethnic protest in Europe. *International Journal of Comparative Sociology* 54(4):298-324.

Da Roit, Barbara, Marcel Hoogenboom, and Bernhard Weicht. 2015. The gender informal care gap: A fuzzy-set analysis of cross-country variations. *European Societies* 17(2):199-218.

Da Roit, Barbara, and Bernhard Weicht. 2013. Migrant care work and care, migration and employment regimes: A fuzzy-set analysis. *Journal of European Social Policy* 23(5):469-86.

Damonte, Alessia. 2014. Policy tools for green growth in the EU15: A Qualitative Comparative Analysis. *Environmental Politics* 23(1):18-40.

Dardanelli, Paolo. 2014. European integration, party strategies, and state restructuring: A comparative analysis. *European Political Science Review* 6(2):213-236.

Davidsson, Johan Bo, and Patrick Emmenegger. 2013. Defending the organisation, not the members: Unions and the reform of job security legislation in Western Europe. *European Journal of Political Research* 52(3):339-63.

Dong, Bingying, Ling Zhu, Kevin Li, and Meifeng Luo. 2015. Acceptance of the international compensation regime for tanker oil pollution - And its implications for China. *Marine Policy* 61:179-86.

Fischer, Manuel. 2014. Coalition structures and policy change in a consensus democracy. *Policy Studies Journal* 42(3):344-66.

Fischer, Manuel. 2015. Institutions and coalitions in policy processes: A cross-sectoral comparison. *Journal of Public Policy* 35(2):245-68.

Fitjar, Rune Dahl, Einar Leknes, and Janne Thygesen. 2013. Europeanisation of regional policy making: A Boolean analysis of Norwegian counties' participation in the EU's Interreg programme. *Environment and Planning C-Government and Policy* 31(3):381-400.

Grauvogel, Julia, and Christian von Soest. 2014. Claims to legitimacy count: Why sanctions fail to instigate democratisation in authoritarian regimes. *European Journal of Political Research* 53(4):635-53.

Guzman-Concha, Cesar. 2015. Radical social movements in Western Europe: A configurational analysis. *Social Movement Studies* 14(6):668-91.

Heijden, Jeroen van der. 2015. The role of government in voluntary environmental programmes: A fuzzy-set Qualitative Comparative Analysis. *Public Administration* 93(3):576-92.

Hörisch, Felix, and Jakob Weber. 2014. Capitalizing the crisis? Explanatory factors for the design of short-time work across Organisation for Economic Co-operation and Development countries. *Social Policy & Administration* 48(7):799-825.

Jano, Dorian. 2015. Compliance with EU legislation in the pre-accession countries of South East Europe (2005-2011): A fuzzy-set Qualitative Comparative Analysis. *Journal of European Integration* 38(1):1-22.

Kulessa, A. von, and G. Wenzelburger. 2015. Stronger tax competition - strong reforms? A newer view on corporate tax reform in 15 EU-nations (1998-2011). *Swiss Political*

Science Review 21(2):302-32.

Laux, Thomas 2015. Nation-state processes or global structures? Analyzing the mechanisms for gender equality in law. *Berliner Journal für Soziologie* 24(4):531-58.

Moraski, Bryon J. 2013. Constructing courts after communism: Reevaluating the effect of electoral uncertainty. *Communist and Post-Communist Studies* 46(4):433-43.

Owens, Peter B., David Cunningham, and Geoff Ward. 2015. Threat, competition, and mobilizing structures: Motivational and organizational contingencies of the civil rights-era Ku Klux Klan. *Social Problems* 62(4):572-604.

Palm, Trineke. 2013. Embedded in social cleavages: An explanation of the variation in timing of women's suffrage. *Scandinavian Political Studies* 36(1):1-22.

Perry, Ashley M., and Mark J. Schafer. 2014. Resilience in Louisiana FEMA parks: A person-centered fuzzy-set analysis. *Sociological Spectrum* 34(1):39-60.

Schneider, Carsten Q., and Kristin Makszin. 2014. Forms of welfare capitalism and education-based participatory inequality. *Socio-Economic Review* 12(2):437-62.

Schoon, Eric W. 2014. The asymmetry of legitimacy: Analyzing the legitimation of violence in 30 cases of insurgent revolution. *Social Forces* 93(2):779-801.

Stiller, Sabina. 2015. The interplay of actor-related strategies and political context: A fuzzy-set QCA analysis of structural reforms in continental welfare states. *Journal of European Public Policy* 24(1):1-19.

Stockemer, Daniel. 2013. Fuzzy set or fuzzy logic? Comparing the value of Qualitative Comparative Analysis (fsQCA) versus regression analysis for the study of women's legislative representation. *European Political Science* 12(1):86-101.

Thomann, Eva. 2015. Customizing Europe: transposition as bottom-up implementation. *Journal of European Public Policy* 22(10):1368-87.

—. 2015. Is output performance all about the resources? A fuzzy-set Qualitative Comparative Analysis of street-level bureaucrats in Switzerland. *Public Administration* 93(1):177-94.

Verweij, Stefan, and Lasse M. Gerrits. 2013. Understanding and researching complexity with Qualitative Comparative Analysis: Evaluating transportation infrastructure projects. *Evaluation* 19(1):40-55.

Young, Kevin L., and Sung Ho Park. 2013. Regulatory opportunism: Cross-national patterns in national bank and regularoty responses following the global financial crisis. *Public Administration* 91(3):561-81.