Case studies nested in fuzzy-set QCA on sufficiency: formalizing case selection and causal inference

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Abstract

Qualitative Comparative Analysis (QCA) is a method for cross-case analyses that works best when complemented with follow-up case studies focusing on the causal quality of the solution and its constitutive terms, the underlying causal mechanisms, and potentially omitted conditions. The anchorage of QCA in set theory demands criteria for follow-up case studies that are distinctively different from those known from regression-based multi-method research (MMR). Based on the evolving research on set-theoretic MMR, we introduce principles for formalized case selection and causal inference after a fuzzy-set QCA on sufficiency. Using an empirical example for illustration, we elaborate on the principles of counterfactuals for intelligible causal inference in the analysis of three different types of cases. Furthermore, we explain how case-based counterfactual inferences on the basis of QCA solutions are related to counterfactuals in the course of processing a truth table in order to produce a solution. We then elaborate on two important functions that ideal types play for QCA-based case studies: first, they inform the development of formulas for the choice of the best available cases for with-case analysis and, second, establish the boundaries of generalization of the causal inferences.

1. Introduction

Qualitative Comparative Analysis (QCA) discerns *set-relational patterns* in a population of cases (Berg-Schlosser, De Meur, Ragin, and Rihoux 2008). In and of themselves, such cross-case patterns do not necessarily reflect causation and are uninformative about the underlying causal mechanisms. Moreover, in applied research, it is not uncommon that some cases deviate from the cross-case pattern revealed via QCA. Case-oriented researchers are routinely interested as to why these cases exist and in what way theory and the analysis need to be improved in order to be able to explain them (Berg-Schlosser, De Meur, Ragin, and Rihoux 2008: 44-56; Ragin 1987: 113-118). A QCA run on the cross-case level cannot address these issues, a shortcoming that all cross-case methods share (Achen 2005).We thus face the need to perform case studies and process tracing *on the basis of QCA results*. Two key goals of case studies grounded in a cross-case analysis are, first, to analyze *causal mechanisms* linking cause to outcome in typical cases and, second, to engage in exploratory research addressing *the puzzle of deviant cases* (Bennett and Elman 2006: 473-474; Lieberman 2005).[2]

The combination of QCA and follow-up case studies, which has come to be termed set-theoretic multi-method research (set-theoretic MMR, Schneider and Rohlfing 2013), is becoming more and more common in empirical research (e.g., Alemán 2010; Samford 2010; Schneider 2008; Segura-Ubiergo 2007; Suzuki and Loizides 2011). In addition, themethodsliteratureispayingincreasingattentiontothelogicandprocedureofset-theoretic MMR(Ragin and Schneider 2011; Rihoux and Lobe 2009).A particular focus has been placed on the general compatibility of single-case process tracing with QCA performed on a population of cases(Beach and Pedersen 2013: chap. 8; Blatter and Haverland 2012: chap. 5), the informal logic of case selection on the basis of QCA results for necessity and sufficiency (Ragin and Schneider 2011), and the insights that can be derived from QCA in order to

[2] See Rihoux and Lobe (2009) for a general discussion of the need for case knowledge in QCA and Gordon and Smith (2004) for a formalization of case knowledge in a statistical context.

sharpen the focus of follow-up case studies, and vice versa (Rohlfing and Schneider 2013; Schneider and Rohlfing 2013). This literature makes important contributions to the development of set-theoretic MMR, for the unreflected transfer of principles and practices from better known regression-based MMR (e.g., Goerres and Prinzen 2012; Lieberman 2005; Rohlfing 2008; Rohlfing and Starke 2013) is not meaningful due to important differences between regression analysis and set-theory-based QCA (Goertz and Mahoney 2012: chap. 17; Ragin 2008: chap. 11).

One crucial feature of QCA as a set-theoretic method is the distinction between necessary and sufficient conditions. During the last 15 years, cross-case analyses aiming at identifying patterns of *necessity* have received increasing attention (Braumoeller and Goertz 2000; Goertz and Starr 2003; Levy and Goertz 2007; Ragin 2000: chap. 8 ; Schneider and Wagemann 2012: chaps. 6, 8). Drawing on this work, principles for case studies after a QCA on necessity have been developed, including guidelines for formalized case selection and causal inference (Rohlfing and Schneider 2013)

Against this backdrop, what is lacking is a formalized treatment of rigorous set-theoretic MMR in QCA on *sufficiency*. This is a formidable gap because empirical studies on sufficiency outnumber inquiries on necessity (Mello 2012). Principles established for QCA on necessity cannot be easily transferred to the domain of sufficiency due to distinct nature of the two forms of set relations (Levy 2008; Most and Starr 1989: chap. 3). This means that the larger share of QCA studies currently lacks clearer guidelines on how to formalize the integration of a sufficiency analysis with case studies.[3] In particular, four important issues have not yet been addressed in detail: first, the logic of *counterfactual inferences* in single-case studies based on QCA solutions that reflect equifinality and conjunctural causation;[4]

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[3] Arguably, this "sufficiency bias" (Schneider and Wagemann 2012: 220) stems from the fact that, in essence, QCA as a technique consists of analyzing a truth table and each truth table row is a statement of sufficiency (Ragin 1987: chap. 5).

[4] We do not explain in detail here why we follow a difference-making criterion for causal inference and the idea of counterfactual inference in particular, which is eminent in set-relational reasoning (e.g., Steglich-Petersen

second, the use of fuzzy-set memberships for *formalized case selection* aiming at identifying the best available case for analysis; third, the scope of *generalizations* of the insights derived from case studies; and, fourth, the proper *sequence* in which the different types of case studies that are available in set-theoretic MMR should be implemented. By addressing these points, we contribute to the advancement of the existing literature in multiple directions and to the rigor of causal inference in set-theoretic MMR.

In section two, we present the leading empirical example that guides our discussion and arguments throughout the paper. In the third section, we introduce the logic of counterfactuals for scenarios that we commonly confront in QCA, i.e., patterns of equifinality and conjunctural causation at the cross-case level with consistency and coverage scores of less than 1 (but beyond a commonly accepted minimum threshold for consistency). We first focus on causal inference on *typical cases* and detail the requirements for counterfactuals substantiating the inference that a conjunction is causal. We show that this in turn requires a counterfactual for every constitutive condition of the conjunction (i.e., every INUS condition, Mackie 1974: chap. 3).[5]Moreover, we explicate the counterfactual needed for causal inference on the *causal mechanism* connecting the conjunction to the outcome. We demonstrate that this counterfactual follows a different rationale than counterfactuals on INUS conditions. Shifting to *deviant cases consistency* and *deviant cases coverage*, we show that each type of case demands a different protocol of counterfactual inference, thus highlighting the importance of the distinction between different types of cases in set-theoretic MMR (Schneider and Rohlfing 2013).Building on our discussion of counterfactuals, we explain the relationship and salient differences between counterfactuals invoked for the generation of the

2012). We note that counterfactual inferences in single-case studies in line with QCA (see below and Ragin 2008: chaps. 8-9). We also note that criteria for good counterfactuals have been discussed in detail in the literature and are not further explored here (Bunzl 2004; Emmenegger 2011; Lebow 2010; Lewis 1973a, 1973b; Mackie 1974).

[5] INUS conditions are defined as conditions that are individually necessary parts of a conjunction that is unnecessary, but sufficient.

intermediate and parsimonious solution on the one hand, and case-study based counterfactuals realized for causal inference on the other. We conclude the third section with a discussion of the proper sequence in which the three types of cases should be analyzed.

In section four, we make a second contribution to the existing literature by explaining how information about the fuzzy-set membership of cases can be used for formalized case selection. Schneider and Rohlfing (2013) give an informal exposition of how differences in degree established by fuzzy-set memberships can be utilized for case selection. We go beyond this and draw on the role and meaning of *ideal types* in fsQCA. Taking the idea of ideal types as the basis, we proceed with the formulation of mathematical formulas that guide formalized case selection and allow us to choose the best case of all cases that are available for analysis.[6]

In section 5, we first bring attention to the idea that set-theoretic MMR faces the challenge of generalizing the inferences derived from the study of one case to other, similar cases (Kühn and Rohlfing 2010). The questions of how much (or how little) we can generalize and what "similar cases" are addressed in the fifth section. Again invoking ideal types, we argue that the breadth of causal inference derived from case studies is limited to all other members of the same type. The final section concludes with a discussion of avenues for future research on set-theoretic MMR. Before we present our empirical example, we note that we assume the familiarity of the reader with central concepts and protocols of set-theoretic MMR and different types of cases on sufficiency, and the rationale for analyzing them in-depth(for a detailed treatment, see Schneider and Rohlfing 2013).

2. The empirical example: constitutional control of executives

Our discussion of formalized case selection is illustrated with Pennings'(2003) fsQCA on the conditions for constitutional control of executives by the parliament and the head of state (set

[6]Rohlfing and Schneider (2013) present such formulas for case selection after a cross-case analysis of *necessity*.

name *CONSTCON*)[7] in 43 parliamentary democracies during the period from 1945 to 1998. Pennings investigates four conditions: consensus democracy (*CONSDEM*); semi-presidentialism (*SEMIPRES*); new democracy (*NEWDEM*); and rigid constitution (*RIGCONST*).[8] Table 1 presents the empirical evidence in a truth table. For each of the 16 logically possible combinations of the four conditions, it reports how consistent each of these 16 rows is with the statement of being sufficient for outcome *CONSTCON* (column "Consistency"); whether we consider it as consistent enough as a sufficient term (column "Sufficient for *CONSTCON*"); and which of the 45 cases holds a fuzzy set membership higher than 0.5 in each row (last column). This truth table forms the basis for the analysis. Each row with value 1 in column "Sufficient for *CONSTCON*" (rows 3 and 9-12) is included into the logical minimization procedure.

This yields the conservative solution as shown in Table 2.[9] We find two sufficient terms for achieving high levels of constitutional control: either a consensus democracy is combined with the absence of semi-presidentialism, and/or the absence of semi-presidentialism is combined with a non-rigid constitution in a new democracy. The solution formula is neither fully consistent, nor does it achieve full coverage. However, it meets the conventional threshold of 0.75 and consistency for each term is higher. Moreover, coverage points to substantive relevance, meaning there is a reasonable starting point for informed case selection.

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[7] Sets are written in upper-case letters and italics. ~ denotes the negation of a set.

[8] Because of our focus on methodological issues, we keep the substantive discussion short and refer the reader to Pennings (2003) for more details. We do not aim to make any substantive contribution to any field of research. Furthermore, we leave issues of robustness aside here (Skaaning 2011). The Russian Federation has been excluded due to missing data and all fuzzy-set membership scores of exactly 0.5 have been recalibrated to 0.55 (see Ragin 2008: 131, fn2). The data is available online (*URL*).

[9] For different types of solutions and treatments of logical remainders, see Ragin (2008: chaps. 8-9), Schneider and Wagemann (2012: chap. 8), and our discussion below.

Table 1: Truth table for data of Pennings (2003)

Row	Conditions				Sufficient for	Consistency	Membership >.5 in row
	CONSDEM	SEMIPRES	NEWDEM	RIGCONST	CONSTCON		
1	1	0	1	0	1	0.91	BUL, EST, HU, ISR
2	1	0	1	1	1	0.86	GER, LV, MAC, RO, TR
3	0	0	1	0	1	0.85	ES, LT, MLT
4	1	0	0	1	1	0.80	BE, DK, NL
5	1	0	0	0	1	0.79	LUX, NZ, S
6	0	0	1	1	0	0.78	BD, GUY, JP, JA
7	1	1	1	0	0	0.78	CZ, IT, PL, SK, SLO
8	1	1	1	1	0	0.77	F
9	0	0	0	0	0	0.76	GB
10	0	0	0	1	0	0.75	AUS, CDN, IRL
11	0	1	1	1	0	0.68	GR, IND, POR, PK, ZA
12	1	1	0	0	0	0.68	IS
13	0	1	1	0	0	0.66	CL, NAM, BO
14	1	1	0	1	0	0.62	A, FIN
15	0	1	0	0	-	-	-
16	0	1	0	1	-	-	-

Note: Adapted from Schneider and Wagemann(2012): table 7.2.

The structure of the solution formula in Table 2 is common in empirical QCA studies because it includes both core features (Ragin 1987): multiple conditions occur together for producing the outcome (conjunctural causation); there is more than one sufficient term that leads to the same outcome (equifinality)[10]; and the empirical evidence is not fully in line with the set-theoretic statement of sufficiency, i.e., both consistency and coverage scores are not 1.As we will show, these features play crucial roles in the classification and choice of cases in set-theoretic MMR.

Table 2: Solution formula for "high constitutional control of the executive" (*CONSTCON*)

	CONSDEM~SEMIPRES* (term 1)	*+ NEWDEM*~SEMIPRES*~RIGCONST* (term 2)
Consistency	0.77	0.84
Raw coverage	0.69	0.57
Unique coverage	0.23	0.11
Solution consistency	0.75	
Solution coverage	0.80	

Based on the fsQCA solution term, each case can be assigned to one of five types of cases that are available inset-theoretic MMR: typical cases, deviant cases for consistency in kind, deviant cases for consistency in degree, deviant cases for coverage, and individually irrelevant (IIR) cases.[11] As we demonstrate, the classification of cases according to the five-fold scheme is

[10] The combination of both features implies that we are dealing with five INUS conditions. Although *~SEMIPRES* is part of all sufficient terms, it does not qualify as a necessary condition due to a false-positive (consistency of 0.86 in a separate test of necessity). Schneider and Wagemann (2012: chap. 9) discuss this phenomenon under the label of false necessary condition.

[11]In contrast to Schneider and Rohlfing (2013), we do not distinguish between what they call irrelevant cases and individually irrelevant cases. We elaborate the reasons for our decision below in our discussion of deviant cases coverage and the importance of membership in *truth table rows* for this type of case and individually irrelevant cases. Moreover, we speak of deviant cases consistency instead of true logical contradictory cases which is a term coined by Schneider and Wagemann (2012: 127) and refers to the same phenomenon.

essential in several respects. First, the purpose of the within-case analysis depends on the type of case at hand. Second, different types require different mathematical formulas for identifying the best available case. Third, the boundaries between types of cases establish the scope of generalization of findings generated via the in-depth study of just one case within the same type. Fourth, different types of cases require different aims of within-case analysis and trigger different consequences for the cross-case solution formula. Table 3 provides information as to which cases belong to which of the five types of cases based on the QCA result in Table 2. We focus on typical cases, deviant cases consistency in kind, and deviant cases coverage because only they are relevant to causal inference *in single-case studies*.[12]For typical cases, we further distinguish between cases that are *unique members* and those that are *joint members* of solution terms. A typical case is a unique member if it has a membership of 0.5 in only one solution term. In contrast, a joint member is a member of at least two terms of the solution. For reasons that we elaborate on in sections three and four, the distinction between unique and joint members is essential for typical cases but can be ignored in the analysis of deviant cases for consistency.

A typical case is a member of one or more sufficient terms and the outcome and its membership in the term and outcome are consistent with the statement of sufficiency. These cases, of which we have five in our dataset, are typical because they are empirical instances of a sufficient relationship between the term and the outcome.[13]

Table 3: Types of cases in the empirical example

	Member of term 1	**Member of term 2**	**Non-member**

[12] Individually irrelevant cases (IIR) play a role in comparative within-case analyses. Deviant cases consistency in degree should only be chosen if no deviant case consistency in kind is at hand (see Schneider and Rohlfing 2013: 582).

[13] The case is typical in a two-fold sense. First, it is typical for the sufficiency relation of which it is an empirical instance. Second, it is typical for other consistent cases that are also members of the same term and the outcome. In both understandings, we also take the case as a representative case (Seawright and Gerring 2008) because it represents the set relation and is representative for other typical cases (pending evidence to the contrary).

			of solution
Uniquely typical	Germany, Latvia, Macedonia	-	
Jointly typical	Estonia, Hungary		
Deviant consistency in kind	Belgium, Lithuania, Malta, New Zealand, Turkey		
Deviant cases consistency in degree:	Bulgaria, Denmark, Israel, Luxembourg, theNetherlands, Romania, Spain, Sweden		
Deviant cases coverage			Czech Republic, Greece, Ireland, Italy, Poland, Portugal, Slovakia, South Africa
IIR cases:			Australia, Austria, Bangladesh, Bots-wana, Canada, Finland, France (V. Republic), Guyana, Iceland, India, Jamaica, Japan, Namibia, Pakistan, Slovenia, Sri Lanka, United Kingdom

A deviant case consistency is a member of at least one sufficient term and should display the outcome but does not. We have thirteen cases for which the difference between the expected membership in Y and its actual non-membership constitutes the puzzle one sets out to solve via a within-case analysis.[14] A deviant case coverage is described by the opposite constellation: it is a non-member of all sufficient term identified in the QCA solution and should be a non-member of the outcome but is, in fact, a member of Y. In our dataset, there are eight cases that fulfill this criterion.

To illustrate our methodological points, we focus on the term *CONSDEM*~SEMIPRES*. All our methodological arguments extend, of course, to the second term as well. Our goal is to discuss case selection and causal inference on the two INUS conditions constituting the term *CONSDEM*~SEMIPRES* – that is, *CONSDEM* and *~SEMIPRES,* respectively – and the causal mechanism linking it to the outcome. For the purpose of clarification, we lay the foundation for the discussion of inferences on causal mechanism by briefly spelling out a simple mechanism that could connect this term to the outcome.[15] For the sake of our methodological argument, we theorize that a high quality political discourse culture (*DISC*) constitutes the causal mechanism linking *CONSDEM*~SEMIPRES* to *CONSTCON*. This is due to the institutional environment of a consensus democracy and a non-presidential system fostering a "talk culture of deliberation"(Steiner, Bächtiger, Spörndli, and Steenbergen 2004)which, in turn, leads actors to establish formal rules that constrain the executive (*CONSTCON*). The talk culture of deliberation

[14] Two cases, Bulgaria and Israel, are both members of the two sufficient terms. Their membership in one term is smaller than their membership in Y, while the membership in the other term is larger than the membership in Y. These cases are taken as deviant cases for consistency in degree. The reason is the maximum-scoring rule tied to the logical OR-operator according to which a case receives the maximum membership of all terms in which a case is a member.

[15] A related inferential goal, which is not further explored here, consists of discerning the *sequence* in which INUS conditions might have to occur in order to exert a causal effect. A sufficient term such as *CONSDEM*~SEMIPRES* does not indicate whether the two INUS conditions occurred simultaneously or sequentially and, if the latter, which of the INUS conditions occurred first. Process tracing, and probably sequence analysis (Mahoney, Kimball, and Koivu 2009), are suitable tools for the analysis of temporality and sequences (Hall 2008; Mahoney 2012) and allow us to discern whether the two conditions occur in a specific order and are supplemented by corresponding causal mechanisms. Temporal QCA (TQCA, Caren and Panofsky 2005) and Coincidence Analysis (CNA, Baumgartner 2009, 2013a; Baumgartner and Epple 2013) are two set-relational techniques that allow for the discovery of sequences of INUS conditions at the cross-case level. Still, it holds that cross-case evidence for sequences of INUS conditions does not necessarily imply that the conditions indeed work sequentially because the cross-case evidence need not reflect causation and the actual sequence. Thus, process tracing is also required when TQCA and CNA are applied to cross-case data.

implies that the executive implements policy decisions that were reached in consensus with the involved political actors. In order to ensure that the implementation of the policies is in line with the results derived from deliberation, the executive faces tight constitutional constraints. Formally, we can put this in set-relational notation as *CONSDEM*~SEMIPRES→DISC→CONSTCON*. Following the idea that a mechanism achieves productive continuity (Machamer, Darden, and Craver 2000), the arrows in this notation represent temporal order and causal dependence in the form of sufficiency (Machamer 2004). The presence of the conjunction *CONSDEM*~SEMIPRES* is sufficient for triggering the mechanism *DISC*, and the presence of mechanism *DISC*, in turn, triggers the outcome *CONSTCON*.

3. Counterfactual causal inference in QCA-based single case studies

The literature on set-theoretic MMR has introduced different types of case that we can select and examine on the basis of QCA results. There are also guidelines for what to focus on in within-case analyses of each type of case. While this is a welcomed advancement of set-theoretic MMR, we argue that existing advice comes short of providing the full picture for causal inference. Causal inference that follows the *epistemological* criterion of difference-making on the level of individual cases requires a comparison of the observed case – the factual case – with a counterfactual case (Lewis 1973a, 1974). Single-case causal inference is based on a counterfactual, i.e., a theoretically relevant manipulation of the observed case in order to ascertain whether this manipulation would make a difference to the outcome.[16]

[16] See Rohlfing and Schneider (2013) for counterfactual inferences in analyses of necessary conditions.

So far, however, the literature on set-theoretic MMR dealing with sufficiency only focuses on the observed cases and ignores the counterfactual case required for causal inference.[17] For typical cases, for example, the recommendation is simply to select a typical case in order to substantiate the causal inference that a term is indeed sufficient and to discern the causal mechanism(Schneider and Rohlfing 2013: 573). While we of course need to choose a typical case for this purpose in ways we describe below, we show that causal inference requires multiple counterfactuals on the sufficiency of the term and the mechanism tied to this term. Multiple counterfactuals are required because each INUS condition demands its own counterfactual. The same holds for deviant cases consistency and coverage, the other two types of cases that are suitable objects for single-case process tracing. In the deviant case consistency, we know that an INUS condition is missing from the sufficient term and that the deviant case consistency is not a member of it. Similarly, for deviant cases coverage, we know that an entire term is missing from the solution and that the deviant case coverage must be a member of this term (Schneider and Rohlfing 2013: 574). While the arguments about the membership of deviant cases in omitted terms are correct, they only represent half of the story. For causal inference, we must also assess whether a change of membership in the omitted condition would trigger a change in the outcome for the deviant case.

The following discussion shows that, due to the different nature of typical cases, deviant cases consistency, and deviant cases coverage, we need a different protocol for counterfactual causal inference. For typical cases, we further demonstrate that the logic of counterfactual inference varies depending on whether we are interested in the sufficient term or in the mechanism tying the term to the outcome. On the basis of the QCA results presented above and the designation of each case to one type, we now elaborate on counterfactual causal inference in

[17] See also Goertz and Mahoney (2012: chap. 9) and Levy (2008) for counterfactuals and set relations.

single-case studies. Table 4 lays the groundwork for our discussion by differentiating the purpose of the case study, the required membership type, and the counterfactual involved for each type of case. In addition, we include information about the expected consequences of counterfactuals confirming and disconfirming claims about the causal quality of a term or mechanism.[18]

3.1. *Typical cases*

3.1.1. INUS conditions and sufficient conjunctions

The analysis of typical cases can serve two complementary causal inferences. First, we can collect within-case evidence substantiating the QCA-based inference that a single condition is an INUS condition and the corresponding conjunction to which it belongs is sufficient for the outcome. It is important to emphasize that a causal claim on the sufficiency of an entire conjunction requires performing as many counterfactual causal inferences as there are constitutive INUS conditions. Second, if all INUS conditions are deemed causal, the within-case analysis should focus on the causal mechanism linking the entire sufficient term and the outcome (Hall 2008). This focus on causal mechanism can be done in an exploratory fashion by deriving evidence for a mechanism that has not been theorized prior to the analysis. Alternatively, it can be done by testing - via process tracing - an already existing hypothesis on a causal mechanism (Beach and Pedersen 2013; George and Bennett 2005: chap. 10; Rohlfing 2012: chap. 3).[19]

[18] All the counterfactuals could be substituted by comparative case studies (see Mackie 1974: chaps. 2, 3). A detailed treatment of this issue is beyond the scope of this paper. For an informal exposition of comparative case studies within set-theoretic MMR on sufficiency, see Schneider and Rohlfing (2013).

[19] In addition, one should be open to finding evidence for an omitted INUS condition in a typical case. By now, QCA, unlike regression, does not offer diagnostics for model misspecification. Consequently, the within-case analysis of a typical case should take over this part and be open to evidence pointing to an omitted condition (Lieberman 2005).

Table 4: Types of cases, membership, causal inference, and consequences of single-case studies

Type of case	**Purpose of analysis**	**Membership type of selected case**	**Counterfactual in single-case study**	**Potential consequences for QCA model**	
				Affirmative inference	**Disconfirming inference**
Typical case	(1) Causal inference on INUS condition[20]	Unique member of term	Would mechanism and Y be absent if INUS condition was absent?	Keep INUS condition.	DropINUS condition.
	(2) Causal inference on mechanism	Unique member of term	Would Y be absent if mechanism was absent?	Keep INUS condition.	Drop INUS condition.
Deviant case consistency	Determine INUS condition omitted from term	Unique or joint member of term	Would Y be present if case was member of omitted INUS condition?	Add omitted INUS condition; deviant case becomes IIR case.	Do not modify term; deviant case consistency remains.
Deviant case coverage	(1) Determine omitted solution term by identifying INUS condition omitted from truth table row	Non-member of solution and member of truth table row	Would Y be absent if case was non-member of omitted INUS condition?	Add omitted condition to truth table row; deviant case becomes typical.	Do not modify truth table row; deviant case coverage remains.
	(2) Causal inference on INUS conditions constituting the truth table row	Non-member of solution and member of truth table row	Would Y be absent if case was non-member of any INUS condition?	Keep new sufficient term.	Drop INUS condition; deviant case coverage remains.
	(3) Causal inference on mechanism	Non-member of solution and member of truth table row	Would Y be absent if mechanism was absent?	Keep new sufficient term.	Drop INUS condition; deviant case coverage remains.

[20] We presume we are dealing with INUS conditions; counterfactual inferences in the absence of multiple terms and conjunctions can be easily derived from our arguments.

In the context of single-case studies, we only have evidence showing that the presence of a term is associated with the occurrence of the outcome. When we seek to infer whether a term is sufficient for the outcome, we need to inquire as to whether the presence and absence of each constitutive INUS condition makes a difference to the presence of the outcome (Mackie 1974).[21]

With regard to our empirical example and the term *CONSDEM*~SEMIPRES*, case-study-based causal inference on the term's causal status as a sufficient conjunction thus requires separate counterfactual inferences on the causal quality of both INUS conditions *CONSDEM* and *~SEMIPRES,* respectively. The controlled setting in which the counterfactual must take place derives from the four components of the term "INUS". The condition is (1) in itself insufficient ("I"), but (2) necessary part of a conjunction ("N"), which is (3) unnecessary ("U") but (4) sufficient ("S") for the outcome. The inference that a condition is a necessary element of a sufficient conjunction requires demonstrating that the outcome is absent when the condition is absent. In order to focus on the causal inference on the difference-making quality of a single INUS condition, it follows that for this test, all other INUS conditions belonging to the same term must be present. If we want to claim that *CONSDEM* is a necessary component of *CONSDEM*~SEMIPRES*, we therefore need to evaluate whether the outcome would be absent if we were to observe the conjunction *~CONSDEM*~SEMIPRES*. The same arguments apply to the causal inference on the condition ~SEMIPRES.[22] The individual insufficiency of an INUS condition derives indirectly from affirmative inferences on the other INUS conditions. When we can credibly argue that the outcome would be absent if a case was a member of

[21] We emphasize that counterfactuals are assessed on the level of single cases and not by average effects on the level of an entire sample or the population (Gerring 2012: chap. 12), which is problematic in set-relational analyses (Schneider and Rohlfing 2012).

[22] The simultaneous negation of both INUS conditions is not needed. The counterfactual outcome for the term *~CONSDEM*SEMIPRES* does not yield relevant insights into the causal quality on the single conditions. For causal inference on a conjunction, we need to argue that supersets of the conjunction do not result in the outcome as well. The term *~CONSDEM*SEMIPRES* is not a superset of*CONSDEM*~SEMIPRES*.

*CONSDEM*SEMIPRES* (i.e., *~SEMIPRES* is a necessary element), we have automatically argued that *CONSDEM* is individually insufficient. If *CONSDEM* were sufficient on its own, we should observe the outcome in the presence of *CONSDEM* regardless of whether *~SEMIPRES* is given or not.[23]

The "US" in INUS entails further, essential requirements for the realization of counterfactuals on each INUS condition. The evidence, given the QCA solution, that the conjunction is unnecessary but sufficient, requires the control for the other conjunctions *via the informed choice of cases*. Case selection must achieve control in the context of a counterfactual inference on INUS conditions by following what has been coined the *unique membership principle* (Schneider and Rohlfing 2013: 563). As the term suggests, the unique membership principle requires the selection of cases that are typical cases for *one* sufficient term only. Cases can have membership in more than one term because the logical OR operator denotes the non-exclusionary OR (as opposed to XOR, the exclusive either-or OR). The rationale for the choice of a uniquely covered typical case is to create a setting where it is possible to treat an INUS condition *as if* it was a necessary and sufficient condition. It holds that *only* if we choose a typical case with unique membership in one term, we achieve the best possible setup for counterfactual inferences on a single INUS condition. In other words, the goal of case selection following the unique membership principle is to establish a *symmetric* relation between an INUS condition and the outcome. As a consequence of this, establishing a difference on the INUS condition is expected to make a difference to the outcome as well.[24]

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[23] One might wonder why counterfactual inferences on terms and INUS conditions are needed at all after performing a QCA. The Quine-McCluskey algorithm that underlies the logical minimization of truth tables follows an eliminatory logic, not one of confirmation. Consequently, there is a strong need for counterfactual inferences showing that single INUS conditions make a difference to the outcome. In addition, QCA as a cross-case method generally benefits from the substantiation of cross-case inferences with within-case insights.

[24] Mackie (1974: chap. 3) makes a similar proposal in his discussion of case-based inferences and single INUS conditions.

In order to illustrate the importance of unique membership for counterfactuals on INUS conditions, imagine that we select a jointly covered typical case such as Hungary. Further suppose that our within-case analysis yields empirical evidence substantiating the claim that the term *CONSDEM*~SEMIPRES* is linked to the outcome. We encounter a serious problem in the analysis of a joint member when counterfactually assessing the causal quality of the INUS conditions *CONSDEM* and *~SEMIPRES*, respectively. Since the selected typical case under investigation is a joint member, the counterfactual should lead us to conclude that the outcome is still present when *CONSDEM* or *~SEMIPRES* are absent. The same conclusion would hold if we consider whether any of the constitutive elements of the second conjunction *NEWDEM*~SEMIPRES*~RIGCONST* is an INUS condition.[25] As a consequence, we would have to conclude that no single constitutive term makes a difference to the outcome and that neither of the two terms is, in fact, sufficient. This conclusion is reached by design, i.e., by selecting a jointly covered typical case, not because any INUS condition *is* non-causal (it might be, but we don't know).

Our claim to select a uniquely covered typical case resonates with well-understood broader debates in the methods literature. More specifically, it speaks to the classic problem of *overdetermination* or *empirical underdetermination* in causal inference (Schaffer 2003). In our context, it refers to the co-occurrence of two or more individually sufficient terms (Ragin 2000: 274). Discussions of this problem in philosophy of science offer alternative solutions to this problem because they are concerned with causal inference on a single case. In set-theoretic MMR, in contrast, we are likely to have the choice between multiple, qualitatively identical typical cases

[25] For the term *NEWDEM*~SEMIPRES*~RIGCONST*, there are no unique members among the typical cases. We therefore are left without an option and must revert to the analysis of a joint member.

(see below). As long as one typical case is a unique member, we can engage in counterfactual inference and need not resort to the solutions proposed in philosophy of science.[26]

3.1.2. Causal mechanisms

In the analysis of a single typical case for the term *CONSDEM*~SEMIPRES*, suppose we are able to empirically trace the mechanism 'high quality discourse' (*DISC*, see section 2) between the sufficient term and the outcome.[27]In order to infer that this mechanism is causal, we need to assess whether the presence and absence of the mechanism makes a difference to the presence of the outcome (Hedström and Ylikoski 2010: 53; Machamer 2004). Since this question cannot be assessed empirically in the analysis of a typical case, we need to consider the counterfactual question: would we observe the absence of the outcome if the sufficient term was present, but the mechanism was absent? If we answer "yes" to this question on the basis of process-tracing evidence from the typical case and counterfactual arguments, we have reason to infer that the mechanism is, indeed, causal.

Intelligible causal inference on the mechanism linked to a sufficient term again requires following the unique membership principle. When a typical case is a member of more than one sufficient term, the expectation is that each term is linked to the outcome by a different mechanism. In a jointly covered typical case, there are therefore multiple mechanisms at work. The assumption of multiple mechanisms that work in parallel is highly plausible because a mechanism is instantiated by the sufficient term (Machamer, Darden, and Craver 2000).[28]Trying

[26]Gerring's(2007) pathway cases can be interpreted as the quantitative brethren of our unique membership cases, even if the debate on pathway cases is not explicitly linked to the feasibility of counterfactual inferences.

[27] This line of reasoning fully extends to the assessment of individual sequences that constitute a mechanism (Machamer, Darden, and Craver 2000). For each step of the sequence, we need to determine whether its presence or absence make a difference to the outcome (Machamer 2004).

[28] This holds unless QCA suffers from what can be called a spurious set relation (the equivalent to a spurious correlation), meaning that a sufficient term is not underpinned by a mechanism. This, however, can only be known after all sufficient terms in an equifinal solution formula have been subjected to within-case analysis.

to trace the process linked to one sufficient term in a jointly covered typical case creates the pitfall that we would deem the mechanism linked to one term as non-causal even if it was. The rationale is that in the absence of the mechanism, the outcome would still occur due to the presence of the second mechanism linked to the other sufficient term. The problem of overdetermination at the level of mechanisms (Rohlfing 2012: chap. 7)is avoided by assessing whether one mechanism makes a difference to the outcome while the others are cut off from being operative. Since a mechanism starts with the sufficient term, choosing a unique member and typical case for one sufficient term creates the best setting for counterfactual causal inference on a mechanism.

3.2. Deviant cases consistency

3.2.1. Omitted INUS conditions

Deviant cases consistency constitute a puzzle because they should be a member of the outcome but, in fact, they are not. An interesting feature of this type of case is that we can solve this puzzle via the within-case analysis of unique and joint members. The irrelevance of the type of membership for deviant cases consistency represents a major difference from the analysis of typical cases. The elaboration of this argument first requires a discussion of the *model-related* reason why a case is deviant with regard to consistency.[29]'Model' here refers to the conditions used in the QCA (Ragin 1987). Model-related reasons for deviance generally come in two forms: the inclusion of too many (*overfitting*) or too few (*underfitting*) conditions. The only model-related reason for deviance with regard to consistency is an underfitted model. More precisely, the problem is that an INUS condition has been omitted from a sufficient term (Schneider and

[29] Deviance can have four additional, model-unrelated sources: the wrong delineation of the population via scope conditions (Ragin and Schneider 2011: 164), concept misspecification, the use of invalid or unreliable indicators and sources, and miscalibration of conditions and/or the outcome (Schneider and Rohlfing 2013: 589). While all are important, case studies *after* a QCA are most valuable for discerning model-related reasons for deviance and we exclusively focus on them.

Rohlfing 2013: 573).This holds true because the membership of a case in the term is equal to the minimum membership across the constitutive INUS conditions. Since the membership of a deviant case consistency in the term is too high compared to its membership in the outcome, we need to add an INUS condition of which the deviant case is a *non*-member. Non-membership in the INUS condition implies that the case has a membership of less than 0.5 in that condition. Adding this condition to the original term reduces the case's membership in the expanded created term and it turns from a deviant case into an (individually) irrelevant case.

The line of reasoning in the current literature on handling deviant cases consistency is to add a condition to the existing term (Ragin and Schneider 2011: 159; Schneider and Rohlfing 2013: 573). This strategy can resolve the *observed* deviant case consistency - but it lacks a counterfactual perspective. This is a problem because the simple fact that the deviant case consistency is a non-membership of the omitted INUS condition does not suffice for adding this omitted condition. In addition, we must engage in a counterfactual assessment and ask: if the deviant case was a *member* of the omitted INUS condition, would it be a member of the outcome? The condition should only be added to the term if the answer this question is "yes".

For example, Belgium is a deviant case consistency in kind for the term *CONSDEM*~SEMIPRES*. For the sake of argument, suppose we suspect that the unitary character of a political system (*UNIT*) is the omitted INUS condition.[30] Belgium, as a federal country, is not a member of condition *UNIT*. Furthermore, suppose we are able to gather within-case evidence that the non-unitary character of Belgium (*~UNIT*) is causally related to the absence of the outcome (*~CONSTCON)*. Before adding *UNIT* as the omitted INUS condition to the term, we must first engage in the counterfactual assessment of whether Belgium would have

[30] The clue about the potentially omitted condition might come from theory, common sense, empirical evidence or any combination of these elements. This matter need not concern us here.

constitutional constraints (*CONSTCON*) if it was a unitary state. If we come to the conclusion that constitutional constraints would be in place, the puzzle of Belgium is solved – at least on a counterfactual level – by adding the condition *UNIT* to the model. Since Belgium is not a member of the omitted INUS condition *UNIT*, it is also not a member of the new sufficient term *CONSDEM*~SEMIPRES*UNIT*. Following our discussion in section twoand the minimum-scoring rule for conjunction, Belgium therefore should turn into an individually irrelevant case with regard to the new, expanded term *CONSDEM*~SEMIPRES* UNIT*.

The discussion of counterfactuals related to deviant cases consistency now allows us to explain why the distinction between unique and joint membership does not matter for this type of case. Imagine Belgium was a deviant case consistency with regard to both *CONSDEM*~SEMIPRES* and *NEWDEM*~SEMIPRES*~RIGCONST*.[31]Because of the membership of the deviant case in two underfitted terms, it is necessary to construct one counterfactual for each term *separately*. In the case of Belgium, we first consider the counterfactual of whether Belgium would display the outcome if it was a member of the expanded term *CONSDEM*~SEMIPRES*UNIT*. For the sake of the argument, further assume that the exploratory case study on the second term *NEWDEM*~SEMIPRES*~RIGCONST* reveals that Belgium does *not* display the outcome because it is *not* culturally homogeneous (non-member of condition *CULTHOM*). We now add the condition *CULTHOM* to the term *NEWDEM*~SEMIPRES*~RIGCONST* and address the counterfactual as to whether Belgium would have constitutional controls in place if it was culturally homogeneous. In constructing this counterfactual, we now in turn presume that Belgium is a member of the *original* first solution term *CONSDEM*~SEMIPRES*. One counterfactual thus does not interfere with the other and

[31] We do not have such a case in our example because all deviant cases consistency are unique members and thus will continue with Belgium as the empirical example. By definition, unique members are (individually) irrelevant cases with regard to all other known existing terms.

joint membership of deviant cases consistency. In contrast to typical cases, joint membership is unproblematic for counterfactual causal inferences on deviant cases consistency.

3.2.2. Causal mechanisms

Causal inference on the mechanism linking the sufficient term with the outcome requires considering whether the outcome would be absent in the absence of the mechanism. It seems natural to counterfactually infer from the analysis of a typical case that a mechanism is causal because causal mechanisms can only be operative in typical cases. While such a counterfactual is possible along the lines we described above, the empirical analysis of a deviant case consistency might lend *empirical* support for the causal quality of the mechanism. By definition, a deviant case consistency has the sufficient term in place but lacks the outcome. According to the solution, a deviant case consistency and a typical case are both members of a sufficient term. As a consequence, the absence of the outcome in the deviant case consistency must be due to the absence of the mechanism. Given that we have knowledge about the operation of causal mechanisms in a typical case, the within-case analysis of a deviant case consistency should focus on demonstrating that the mechanism is not at work and why it is not.

For illustration, consider Latvia, which is a typical case for *CONSDEM*~SEMIPRES*, and Belgium as a deviant case consistency of the term *CONSDEM*~SEMIPRES*. Both cases are members of the same term but differ in their outcome. Since the difference in the outcome cannot be due to the differences in the sufficient term, it must be attributable to differences in the mechanism. In fact, process tracing in a deviant cases consistency focusing on this puzzle implies searching for an omitted INUS condition of which the deviant case consistency is not a member. Non-membership in the omitted INUS condition is the reason that the mechanism is not operative. In a counterfactual view, this means that we should only add a condition to the original term if we answer the following question with “yes”: *would the mechanism be operative and the outcome in place if the case was a member of the omitted condition*?

3.3. Deviant cases coverage

Deviant cases coverage are perplexing because they are members of the outcome for reasons not disclosed by the QCA solution. Consequently, none of the identified sufficient terms in the solution provides a good entry point for a case study aiming to resolve this puzzle. The only way to explain the fact that such a case displays the outcome is by unraveling an *entirely new sufficient term*, wherein “new” means that the omitted term is not a subset or superset of the sufficient terms contained in the QCA solution. In terms of model specification, the reason for a deviant case coverage is therefore the *underfitting of the QCA solution*. Building on this insight, the best starting point for the case study is the *truth table row* to which a deviant case coverage belongs. This row is the best available description of the deviant case coverage that we have and can be interpreted as the sufficient configuration producing the outcome in this type of case (Schneider and Rohlfing 2013: 574).

If one follows this line of reasoning, one might wonder why this row is not part of the QCA solution in the first place. The simple reason is that the consistency of the truth table row is below the consistency threshold that is used for considering rows as sufficient for the outcome. For example, Italy is a deviant case coverage that falls into the 7th row of the truth table in Table 1 with a membership of 0.55 in the row and of 0.67 in the outcome. The consistency of that row as a sufficient term for *CONSTCON* is 0.78 and therefore below our threshold of 0.8. Consistency is low because the membership scores of other cases in this row are inconsistent with a pattern of sufficiency (see below).

The counterfactual analysis of deviant cases coverage blends the analysis of typical and deviant cases consistency as described above. In a first step, we address the question of deviance: why is the outcome given for the deviant case coverage but not the other members of the same truth table row? This is similar to the question of why a typical case displays the outcome, but a deviant case consistency that is a member of the same term does not. The model-related solution to this puzzle is again the identification of an omitted INUS condition. The deviant case coverage must be a member of this condition while the other cases in the same row must be non-members. Once we include the condition in the truth table row, it separates the deviant case coverage from the other cases. They now fall into different truth table rows and the deviant case coverage turns into a typical case for its new row.

On the basis of an expanded truth table row, the second and third tasks resemble those discussed in the analysis of typical cases. In step two, we counterfactually examine *every* INUS condition of the new term as to whether it is causal.[32] When we have determined that each condition is causal, we focus on the mechanism in the third step and evaluate counterfactually whether it qualifies as causal. As explained, this means that in the presence of the sufficient term, we assess whether the outcome would be absent if the mechanism linking the term to the outcome was absent.

3.4. Types of solutions and counterfactual inferences

Counterfactuals are, of course, not new to QCA. Researchers implementing QCA routinely perform counterfactuals on so-called logical remainder rows (truth table rows without enough empirical evidence) when logically minimizing a truth table (Ragin 2008: chaps. 6-9; Schneider and Wagemann 2013). The *parsimonious solution* rests on simplifying assumptions. For some

[32] INUS conditions that we consider as not making a difference to the outcome are dropped from the conjunction.

logical remainders, it is assumed that they are sufficient for the outcome if and when these assumptions contribute to parsimony, i.e., if they contribute to eliminating as many INUS conditions as possible from the primitive expressions contained in the truth table. The *intermediate solution* is only built on easy counterfactuals and discards difficult counterfactuals. Counterfactuals are called easy when the assumptions about the outcome of logical remainders are simplifying *and* in line with our directional, i.e., theoretical expectations.[33]A counterfactual is difficult when it is simplifying our solution, but also runs counter to our theoretical expectations about whether single conditions involved in a remainder should or should not contribute to the outcome. Because the intermediate solution does not allow all simplifying assumptions to be made, it contains, technically seen, some INUS conditions that are redundant in the sense that they do not make a difference to the outcome. However, our judgment of redundancy should not depend on whether the elimination of a condition contributes to greater parsimony, but on whether there is a theoretically intelligible basis for the claim that a, INUS condition does not make a difference.[34]

One might think *case-study based counterfactuals* as discussed in this paper simply mimic the counterfactuals made during the minimization of the truth table. If this was the case, case-based counterfactuals would be superfluous. We show, however, that there is a crucial difference. In a nutshell, counterfactuals in a QCA relying on the Quine-McCluskey algorithm for the processing of truth tables follow the logic of elimination. The argument is that an INUS condition in the logical remainder row *doesnot* make a difference to the outcome. In contrast, case-study based counterfactuals follow a confirmatory logic. The counterfactual argument is that an INUS

[33] Schneider and Wagemann(2012: chap. 8) refine this argument by adding the criterion of tenability. No solution term should rest on counterfactual claims on remainders that run counter to common sense, formal logic, or both. We leave this issue aside here, as our arguments also hold when adding tenability to the picture.

[34] In this regard, we disagree with Baumgartner (2013b) who argues that only the parsimonious solution can be interpreted in causal terms.

condition *does* make a difference to the outcome because otherwise it would not be causal. In other words, QCA-based counterfactuals are concerned with arguing that the outcome occurs in the counterfactual (Y = 1), whereas case-study-based counterfactuals are realized in order to show that the outcome would not occur (Y = 0).

Both types of counterfactual are complementary rather than redundant and, given a specific type of solution, focus on different rows. The difference and complementarity of counterfactuals invoked by QCA and follow-up case studies can be illustrated with a hypothetical truth table (Table 5).[35] For the sake of simplicity, both consistency and coverage are 1.[36] The conservative solution is *A*B*D->Y*and derives from the elimination of the logically redundant condition *C* by comparing the first and second row of table 5. The intermediate solution reads *A*D->Y*and is based on the following directional expectations: *~A->Y, ~B->Y, C->Y, D->Y*. The parsimonious solution is *A->Y*.

Table 5 indicates which remainder rows are used for QCA-based and case-study-based counterfactuals. The column "QCA counterfactual *Y*=1" highlights rows that are assumed to be sufficient for *Y*, allowing us to eliminate logically redundant conditions because they do not make a difference to the outcome. Such simplifying assumptions are made on the remainders in rows 3, 5, 10, 11, 12, and 13. Based on these simplifying assumptions, conditions *B* and *D* are eliminated from the conservative solution and we arrive at the parsimonious solution *A->Y*. The entry "Intermediate" in rows 3 and 11 indicates that only these remainders are counterfactually taken as being sufficient for Y when producing the intermediate solution. By making this counterfactual argument, condition *B* is eliminated from the conservative solution.

[35] Our Pennings data cannot be used because the intermediate and parsimonious solutions are identical.
[36] This implies we limit our discussion to typical cases. Our arguments on counterfactuals do apply to the within-case analysis of other types of cases as well, though.

The last three columns in Table 5 show which counterfactuals are made for which logical remainders in follow-up case studies. Since we need to establish that such conditions do make a difference to the outcome, the counterfactual claim must be that a given logical remainder is not sufficient for *Y* (*Y*=0). Table 5 shows that different counterfactuals are needed for causal inferences on conditions *A*, *B*, and *D*, respectively, and that we need different counterfactuals for different types of solutions. For example, if we want to infer that INUS condition *B* in the conservative solution *A**B*D* is causal, we must counterfactually show that *A**~B*D*is *not* sufficient for Y. *A**~B*D* is implied by the two remainders in row 3 and 11, respectively. Hence, the two case-study based counterfactuals on the causal nature of INUS condition *B* effectively entail *A**~B*C*D -> ~Y* and *A**~B*~C*D -> ~Y*.

Table 5 conveys four important insights on counterfactuals in QCA and follow-up case studies. First, at least partially different remainders are involved in QCA-based and case study-based counterfactuals. For example, rows 5 to 9 play a role in case-study based counterfactuals on the causal quality of condition *A*, but they do not matter for counterfactuals needed for the minimization of the truth table. Second, as we move from the conservative solution to the parsimonious solution, we observe an inverse relationship between the number of counterfactuals used in QCA and in follow-up within-case analyses. The more redundancies are contained in the QCA solution, the more case-based counterfactuals are needed to assess the causal nature of individual INUS conditions.

Third, a look at Table 5 might suggest that set-theoretic MMR is fraught by severe problems because we make different assumptions on logical remainders when producing different types of solutions and follow-up case studies. For example, we assume that row 3 comprising *A**~B*~C*D* is sufficient for *Y* when we engage in the case-based counterfactual on the causal quality of *B*with respect to the conservative solution. At the same time, when we derive the intermediate and parsimonious solution from the truth table, we assume that this row is sufficient for the absence of Y.

This might seem to be a logical contradiction in set-theoretic MMR, while in fact, it is not. Set-theoretic MMR (and stand-alone QCA) is done in order to identify the causal recipes for an outcome (Ragin 2008: 9), i.e., a solution that we can interpret in causal terms. It follows that from the three types of solutions we have in QCA, only one solution should be interpreted in causal terms.When we infer that each INUS condition of the conservative solution makes a difference to the outcome, we should stop the processing of the truth table and not derive the intermediate or parsimonious solution because it would yield an underfitted solution. On the other hand, there is no point to stopping at the conservative or intermediate solution if our case-based counterfactuals suggest that at least one INUS condition is not causal for the outcome. For example, if we believe that condition *B* in term *A*B*D* does not make a difference to the outcome, our counterfactuals lead us to conclude that *A*~B*D -> Y*. Notice that the exact same counterfactuals are made (see rows 3 and 11 in table 5) when deriving the intermediate or parsimonious solution with QCA. This highlights that counterfactuals in QCA and follow-up case studies do not contradict each other.

Table5: Three types of solutions and counterfactuals

Row	A	B	C	D	Y	QCA counterfactual Y=1	Case-based counterfactual Y=0		
							on condition A	on condition B	on condition D
1	1	1	1	1	1				
2	1	1	0	1	1				
3	1	0	0	1	?	Intermediate Parsimonious		Conservative	
4	0	1	0	1	?		Conservative Intermediate Parsimonious		
5	1	0	1	0	?	Parsimonious			Intermediate
6	0	0	0	1	?		Intermediate Parsimonious		
7	0	0	1	1	?		Intermediate Parsimonious		
8	0	1	0	0	?		Parsimonious		
9	0	1	1	1	?		Conservative Intermediate Parsimonious		
10	1	0	0	0	?	Parsimonious			Intermediate
11	1	0	1	1	?	Intermediate Parsimonious		Conservative	
12	1	1	0	0	?	Parsimonious			Conservative Intermediate
13	1	1	1	0	?	Parsimonious			Conservative Intermediate
14	0	1	1	0	0				
15	0	0	1	0	0				
16	0	0	0	0	0				

Conservative solution: *ABD -> Y; i*ntermediate solution: *AD -> Y;* Parsimonious solution: *A -> Y*
Directional expectations: *~A->Y, ~B->Y, C->Y, D->Y*

Fourth, when approaching the issue of causality of INUS conditions, a general belief must be qualified according to which conservative solutions do not imply anything about logical remainders. It is true that the conservative solution does not entail any simplifying assumption on logical remainders. However, we do assume that all remainders needed for the case-study based validation of the conservative solution are not sufficient for *Y*. For example, if INUS condition *A* belonging to the term *A*B*D* is claimed to be causal, we must assume that all remainders implying *~A*B*D* (rows 4 and 9) are not sufficient for *Y* because only then does *A* make a difference to the outcome. Similarly, we must assume for *A*~B*D* that it is sufficient for *~Y* (rows 3 and 11) and that *A*B*~D* is sufficient for *~Y* (rows 12 and 13). These assumptions can and should be validated via follow-up case studies and can only be eschewed if we interpret the conservative solution as non-causal, which runs counter to the reason that we ran a QCA in the first place(Ragin 2008: 9).

3.5. Sequence of case studies

The preceding discussion and Table 4 presented above show that the study of different types of cases follows different purposes and procedures. What is not captured by Table 4and our subsequent discussion is the *sequence* by which the different types of case studies should be performed. This is an issue worth considering because, in principle, one should analyze all three types of cases. A within-case analysis of typical cases bolsters confidence in the causal quality of the QCA model, while the choice of both types of deviant cases places the focus on resolving puzzles and improving the QCA model.

We recommend starting with the analysis of typical cases in order to lend credence to the claim that the QCA solution reflects causation in the first place and is not simply an association. If we do not find evidence for the causal quality of the terms comprised by the solution, there is little benefit in turning to deviant cases because they are supposed to be analyzed in order to *improve* a model in which we have a high *ex ante* level of confidence (Rohlfing 2008). The analyses of deviant cases consistency and coverage both seek to refine the existing model, albeit in different ways (adding an INUS condition versus adding an omitted term). We see no hierarchy of importance between these two goals and thus no obvious sequence in the within-case analysis of deviant cases.

4. Formalized case selection for within-case analysis

The assignment of a case to one of the types is a prerequisite for the intelligible choice of cases because each type serves a particular research purpose (Eckstein 1975; Lijphart 1971). For the reasons previously addressed, all cases that belong to the same type are qualitatively identical, while cases belonging to different types are qualitatively different (Collier, LaPorte, and Seawright 2012; Sartori 1970). Following this premise, one might think that random case selection among cases of the same type is a feasible selection strategy because they are all qualitatively identical.[37]In fsQCA, however, we argue that we can and should do better than random selection. We should select cases purposefully and on a formal basis by making use of each case's fuzzy-set membership scores in the term and the outcome.

Our elaboration of formalized case selection starts with a visualization ofPennings' fsQCA result via an enhanced *XY* plot. We then explain how intentional case selection is rooted in the notion of ideal types in fuzzy sets and propose formulas that identify the best available cases, whereby "best case" is understood as the one most closely resembling its respective ideal type.

[37]Fearon and Laitin(2008) develop a different argument for random selection in multi-method research.

4.1. Graphical presentation of types of cases and QCA results

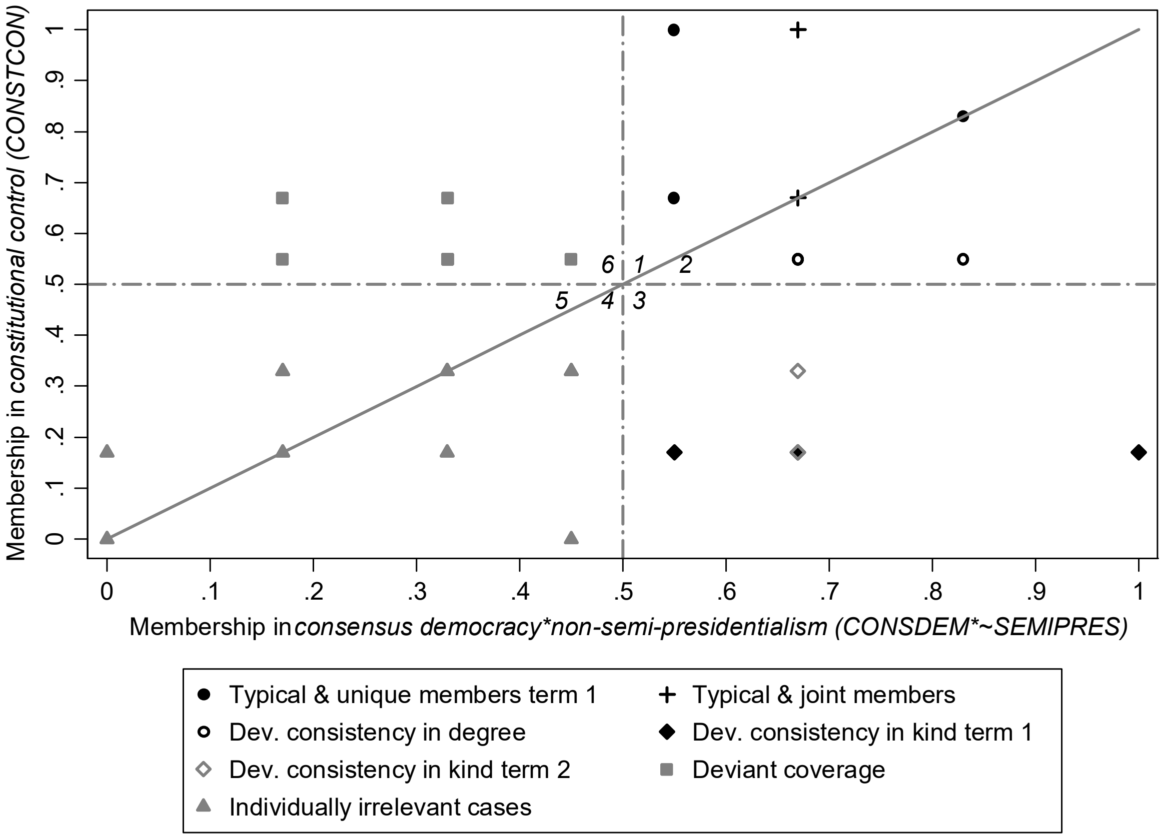
The results of an fsQCA and the assignment of cases to a type can be graphically presented with an enhanced *XY* plot (Figure 1, see Schneider and Rohlfing 2013: 578-579). It consists of a standard *XY* plot (Ragin 2000) combined with a 2x2 table known from crisp-set QCA (e.g., Braumoeller and Goertz 2000). The vertical and horizontal lines anchored at the membership of 0.5 indicate the qualitatively different membership of cases in *X* and *Y*, respectively (Ragin 2000). In addition, the secondary diagonal separates cases that are in line with a statement of sufficiency (above the diagonal) from those that are not (below the diagonal). Each of the five types of cases introduced in section 2 is captured by one of the six zones or areas that are numbered clockwise around the center of the *XY* plot. Figure 1 displays the distribution of our 43 cases across the five types of cases vis-à-vis the sufficient term *CONSDEM*~SEMIPRES*.[38]

4.2. Ideal types in case studies after fsQCA

The key to informed case selection in fsQCA is the concept of *ideal types*, an idea far from novel in fsQCA. Full membership in a fuzzy set expresses full conformity to the ideal type captured by the set. Furthermore, ideal types are integral to the construction of fuzzy-set truth tables and the assignment of cases to truth table rows (Ragin 2008: chaps. 4, 5). We transfer the notion of ideal types to the realm of case selection and show how it can be invoked to identify the most appropriate case for within-case analysis among all cases that belong to the same type.

[38]The *XY* plot does not contain 43 case markers because some cases have identical memberships in both the term and the outcome due to the limited number of set memberships that cases can assume (0, 0.17, 0.33, 0.55. 0.67, 0.83, 1). Consequently, the visible distribution is not informative about the quality of the model and its parameters of fit. The syntax for producing this and all other *XY* plots is available online (*URL*).

Figure 1: *XY* plot and types of cases for *CONSDEM*~SEMIPRES*[39]



In a *qualitative* view, it seems that the upper-right and lower-right corners of the enhanced *XY* plot capture two of the three ideal types that are available for within-case analysis. Qualitatively seen, the *ideal typical case* has a membership of 1 in the sufficient term and the outcome. Such a case is the best possible empirical instance of the term and the outcome, given our calibration rules. If we want to explain how the term produces the outcome, there is no better empirical instance than the one in the upper-right corner of the plot (Schneider and Rohlfing 2013: 581).

[39] The empirical example does not involve typical unique members for term 2 and deviant cases consistency in kind that are joint members.

This argument is not wrong, but it is incomplete because it fails to do justice to the important information on the partial, i.e., fuzzy-set membership of a case in the term. The secondary diagonal in the *XY* plot captures the expected fuzzy-set membership of a case in *Yconditional* on the case's membership in the sufficient term. When a case is a full member of a sufficient term, we expect full membership in *Y* because otherwise, it would be inconsistent. When we are dealing with a case having a membership of, say, 0.8, we do not expect it to be a full member of *Y*, but to have a membership of 0.8 in *Y*. Membership lower than that would be inconsistency, and higher than that would lower coverage. We therefore argue that for the choice of the best available typical case, two criteria must be simultaneously taken into account: first, a short distance to the secondary diagonal and, second, high membership in the term. Thus, the best available typical case is the one farthest to the right and closest to the main diagonal in the *XY* plot.

A similar reasoning applies to deviant cases consistency. The *ideal deviant case consistency* is located in the lower-right corner of the *XY*plot. This case has full membership in the term and the outcome, constituting the biggest puzzle we can think of with regard to consistency. When no case under analysis meets the requirements, the best available case needs to meet two criteria: first, a large distance to the secondary diagonal and, second, high membership in the term. Thus, the best available deviant case consistency is the one farthest to the right and farthest from the main diagonal in the *XY* plot.

The *ideal deviant case coverage* cannot be properly located in an *XY* plot that visualizes a term from the QCA solution, the reason being that this type of case must be selected with regard to the truth table row to which it belongs. Because of the different point of reference, we need to construct separate *XY* plots for each truth table row that contains at least two deviant cases coverage.[40]In *XY* plots related to truth table rows, the meaning and location of ideal cases is identical to those for typical cases. The ideal deviant case coverage is located in the upper-right corner of truth table row-based plot. The best case for analysis then is the one with the minimum distance to the secondary diagonal and the highest membership in the truth table row.

Since the ideal type for a deviant case coverage might be the least intuitive to understand due to the change of perspective from a sufficient term to a truth table row, we illustrate the procedure with an enhanced *XY* plot for the 7th row of the truth table (*CONSDEM*SEMIPRES*NEWDEM*~RIGCONST*). The cases that belong to this truth table row are the Czech Republic, Italy, Poland, Slovakia and Slovenia. In order to highlight the move from solution-based selection to truth table row-based selection, Figure 2 first reproduces Figure 1above and attaches the country names to the marker symbols.

[40] For rows comprising only one deviant case coverage, the question about the best available case is obsolete.

Figure 2: *XY* plot and types of cases for *CONSDEM*~SEMIPRES*

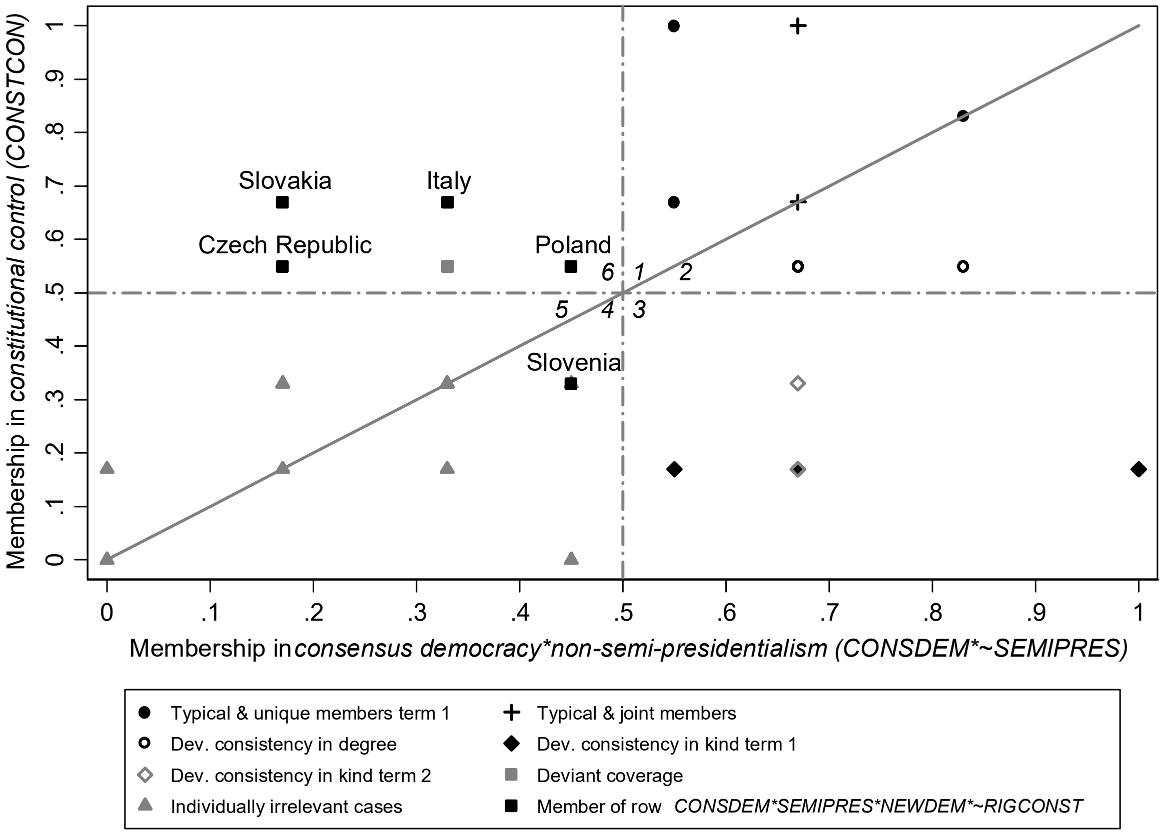
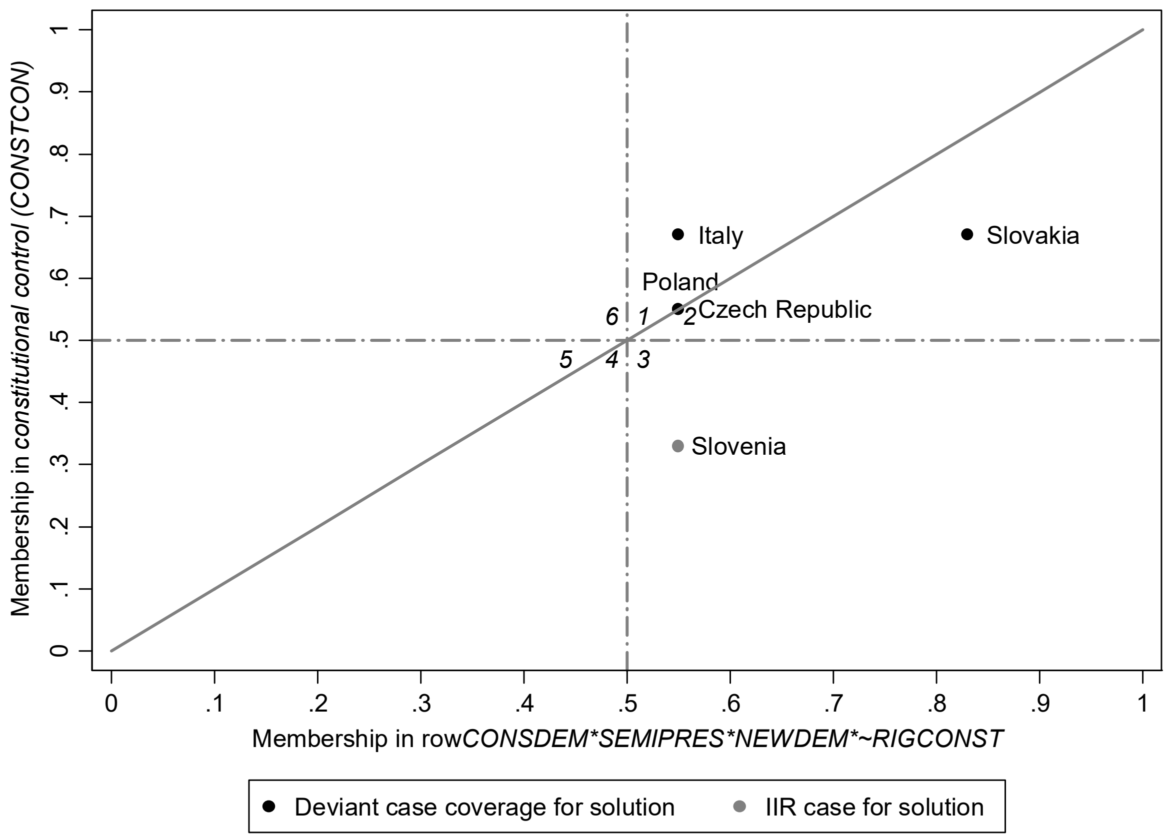


Figure 2 displays the *XY* plot for the 7th truth table row and locatesall five cases from this row in the plot. An enhanced *XY* plot for a truth table row can be interpreted in the same way as an *XY* plot for a term, except that in the former, we are now determining the status of a case with respect to its membership in a single truth table row. Cases in zone 1 of the row-based plot – Czech Republic, Italy, and Poland –are now typical cases in light of the configuration describing their truth table row. This is the pool of cases for selection for within-case analysis when we try to resolve the puzzle of deviant cases coverage. Among the typical cases in the row-based plot, the best case for analysis is the one that best meets the two critertia for typical cases elaborated above.[41]

Figure 3: *XY* plot, truth table row *CONSDEM*SEMIPRES*NEWDEM*~RIGCONST*



Figures 3 and 4 also show why the distinction between irrelevant cases (IR) and individually irrelevant cases (IIR) originally proposed by Schneider and Rohlfing (2013) is redundant. It was introduced in order to identify those cases that are and are not relevant for *comparative* within-case analyses with deviant cases coverage. As explained, the puzzle of deviance coverage is

[41] Figure 2 shows that Slovakia also is a deviant case coverage for the solution, but figure 3 shows that it should not be selected for analysis. Its location in zone 2 of figure 3 reveals that its membership in this row is not consistent with a claim of sufficiency. Slovenia, in addition to being inconsistent, qualifies as a deviant case consistency in kind.

solved by *not* using the known term from the QCA solution as the basis of selection, but the case's membership in its truth table row instead. Since the distinction between IR and IIR cases rests on their membership in the known term, it effectively breaks down when choosing among irrelevant case based on the truth table principle. Figure 2 shows that Slovenia, which would be taken as irrelevant according to the original classification of cases, does have merit for comparative process tracing when it is contrasted with a deviant case coverage from the same truth table row.

4.3. *Formalized case selection after fsQCA*

The elaboration of ideal types with regard to the three types of cases lays the foundation for developing formulas for the formalized choice of the best available case within each type. At present, QCA researchers are equipped with informal principles of QCA-based case selection after crisp-set QCA (csQCA) and fuzzy-set QCA (Ragin and Schneider 2011; Schneider and Rohlfing 2013). These guidelines are exhaustive for csQCA because crisp sets *only* establish qualitative differences between cases. Cases have to be chosen on the basis of their qualitatively similar or different set membership scores in the terms and the outcome, respectively.[42]In contrast, the use of fuzzy-sets allows for expressing differences in degree *among cases that are qualitatively identical*.

This represents a valuable step forward, but it falls short in two respects. First, it is possible that the data at hand will not contain any of the ideal types discussed in the previous section. In the absence of the ideal case, we need rules for selecting the best available cases for each type, i.e., the case that comes closest to the respective ideal type. Second, the notion of "comes closest"

[42] All principles of case selection developed for csQCA can be directly extended to multi-value QCA (mvQCA) because both exclusively invoke differences in kind.

or "resembles most" implies that we are talking about *spatial distances* in an *XY* plot between a given case and the corresponding ideal type and the search for the case that minimizes the distance. Since there are numerous ways to measure spatial distances that are not all equally suitable in the context of fsQCA, it is important to discuss the measurement of distances explicitly.

In some applied QCA studies, the identification of the best available case might be feasible by simple visual inspection of the *XY* plot. However, it becomes less and less likely that this is possible as the number of cases increases, as more fine-grained fuzzy set membership scores are assigned, and the farther away the best available case falls from the respective ideal. The increasing number of large-N QCA studies and the rise of direct and indirect calibration strategies in applied QCA thus make the formulation of formulas for case selection a useful and powerful tool for systematic case selection.

Our formulas are applied to cases of the same type and serve the purpose of ranking these cases according to their suitability for within-case analysis. All three of the following formulas take into account that for any case that is not a full member of the sufficient term, two criteria need to be maximized: being close to the corner of the *XY* plot and being close to the secondary diagonal. Following these premises, the formula for determining the degree to which a typical case *i* approaches the ideal in an analysis of sufficiency, denoted by S_{Ti}, is:

$$(1)\ S_{Ti} = \frac{Y_i - X_i}{X_i}$$

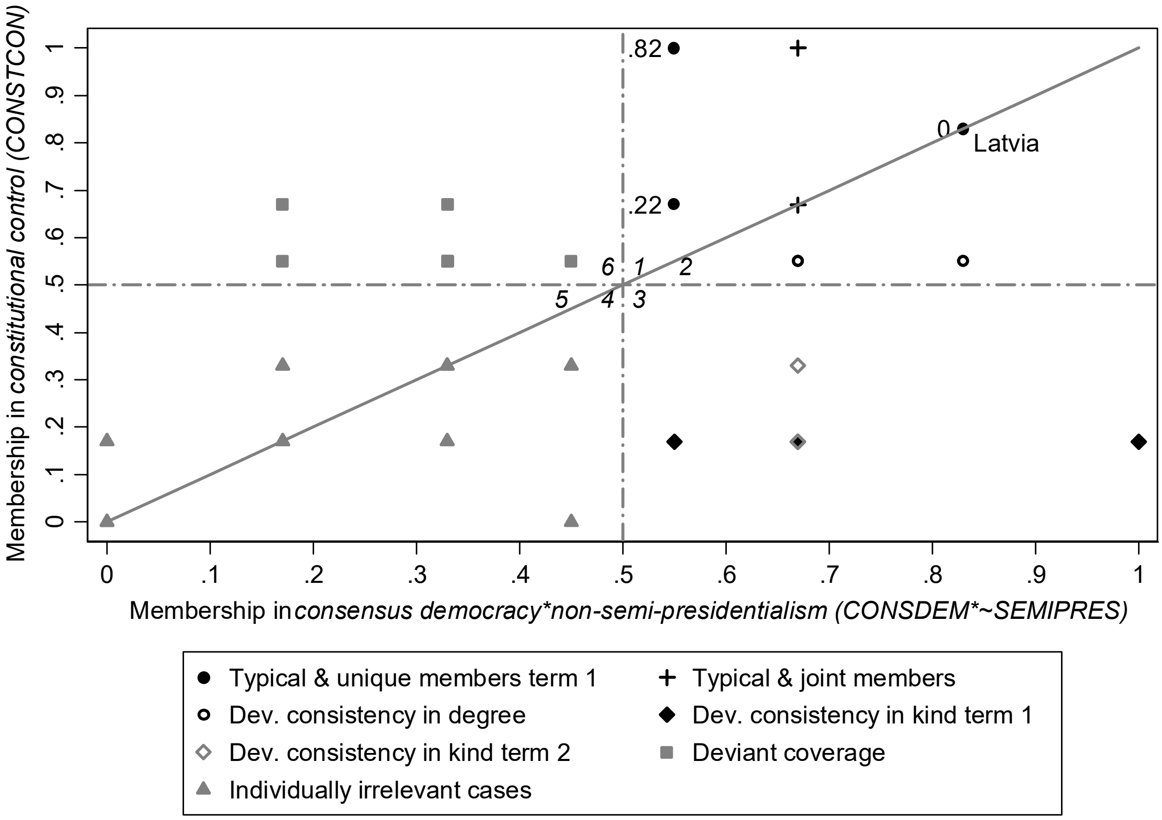
For a given score X_i, the numerator measures the Euclidean distance of the case to the secondary diagonal. The smaller the difference in the membership in *Y* and *X*, the closer the case is to the secondary diagonal and the more appropriate it becomes for process tracing. As explained above, however, the Euclidean distance, which is a common measure of distance, is not suitable because we also need to measure the distance of the case to the corner of the *XY* plot. We take this into account by standardizing the distance to the secondary diagonal with a case's membership in *X*.[43] The rationale is that given the same distance to the diagonal, the case with larger membership in *X* is more suitable for process tracing because it moves closer to the corner of the plot. Since typical cases, by definition, have a larger membership in *Y* than in *X*, larger membership in *X* implies larger membership in *Y* and a closer distance to the upper-right corner of the plot.

For formula 1 and the following two formulas, it holds that smaller values indicate more adequate cases, with 0 being the lower bound. The *XY* plot in Figure 4 presents the formula scores for the typical cases with respect to term 1. Latvia is identified as the best-available typical case as a unique member of term 1 and with a formula score of 0.[44]

[43] This means we also decide against the city block metric as another way to measure the distance to either the corner or the secondary diagonal.

[44] Simulation are available online (*URL*) showing that the formulas produce plausible scores for multiple combinations of membership in *X* and *Y*. The simulation also shows that all cases on the secondary diagonal receive a score of 0. This is at odds with the idea that cases on the secondary diagonal with a higher membership in *X* are more adequate for within-case analysis. While this could be modeled, it would make our formulas unwieldy and less intuitive. We therefore add the informal suggestion that when two cases receive the same score, the one with higher membership in the *X* should be selected.

Figure 4: *XY* plot with formula scores for typical and unique members of term *CONSDEM*~SEMIPRES*



Note: If cases have identical scores, select case with higher membership in *X*

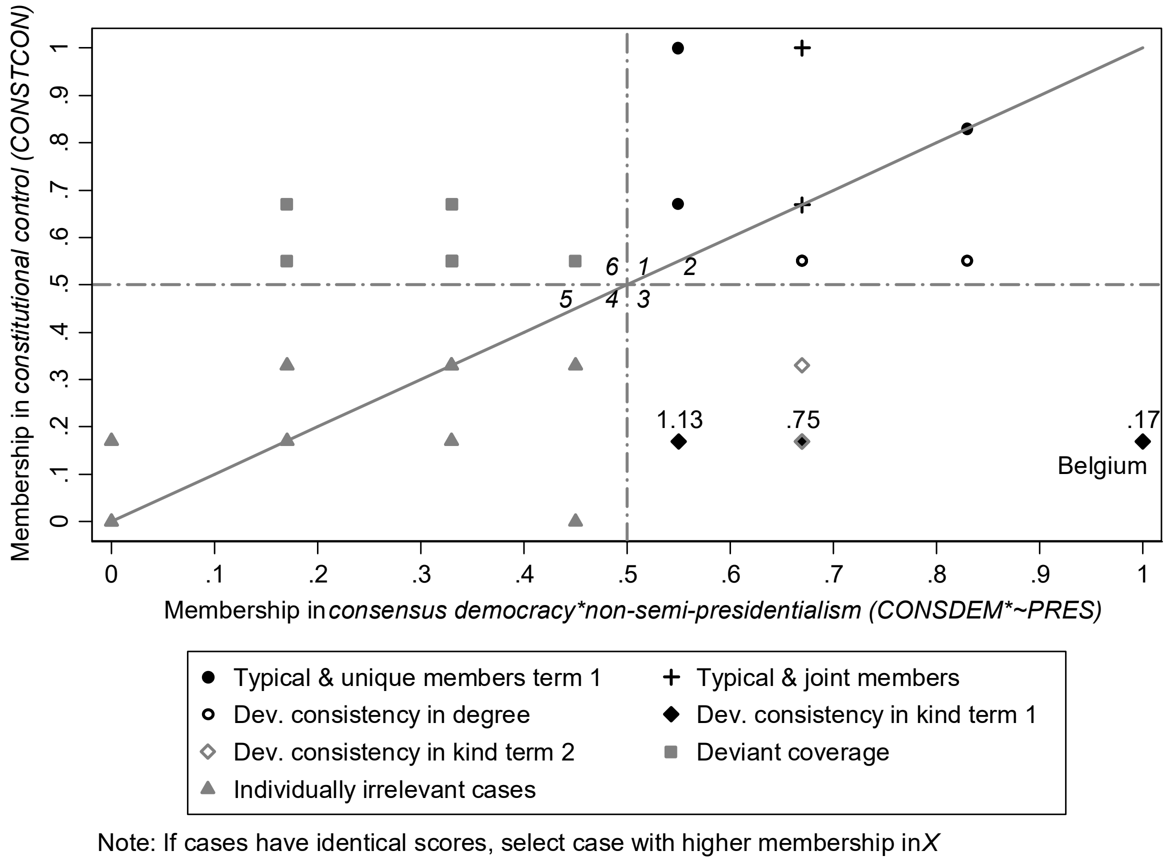
The formula for choosing the best available *deviant case consistency*, abbreviated S_{Dcon}, is:

$$(2)\ S_{Dcon_i} = \frac{1-(X_i-Y_i)}{X_i}$$

The numerator again captures the Euclidean distance of a deviant case consistency to the secondary diagonal. By definition, each case falls below the main diagonal because the upper membership in *Y*is smaller than 0.5and the lower bound for *X* is larger than 0.5. The larger the difference between *X* and *Y*, the more it approaches the secondary diagonal, and the more interesting the puzzle becomes to study in detail. Again, the distance to the secondary diagonal must be put in relation to the size of membership in the sufficient term. Given the same distance to the diagonal, the deviant case consistency with larger membership in *X* is more adequate because it increasingly approaches the ideal located in the lower-left corner. This is why each case's distance to the diagonal is standardized by its membership in *X*. In order to achieve a uniform interpretation of formula scores across all types of cases, we subtract the numerator from 1 because a smaller score then denotes a more appropriate case.

The formula scores for all deviant cases consistency in kind with regard to *CONSDEM*~SEMIPRES* are presented in figure 5. With a score of 0.17, Belgium displays the smallest value and is thus identified as the most appropriate available case for within-case analysis.

Figure 5: *XY* plot with formula scores for deviant cases consistency in kind and unique members of term *CONSDEM*~SEMIPRES*

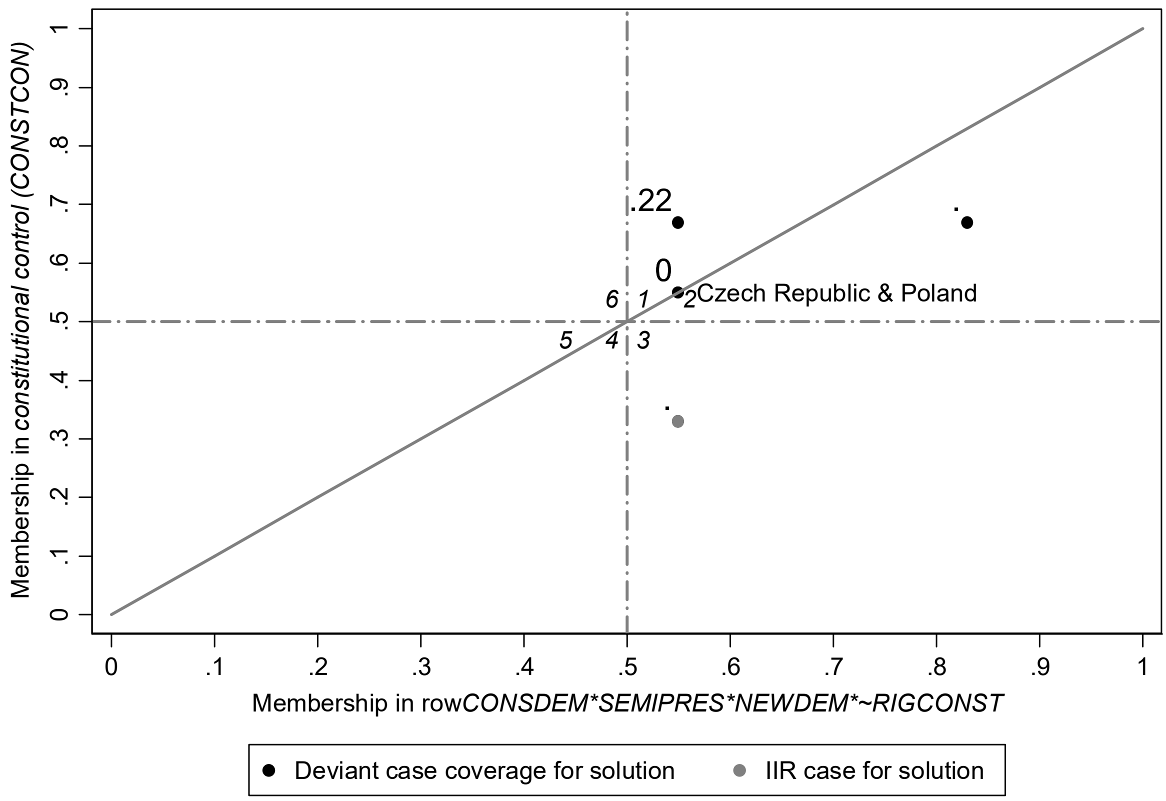


For *deviant cases coverage*, we explained above that the point of reference is the truth table row to which the case belongs. Apart from this salient difference between typical cases and deviant cases coverage, the logic behind formalized case selection is very similar. In fact, the formula for determining the best deviant case coverage, S_{Dcovi}, is identical to the formula for the best typical case (where *X* now represents membership in the truth table row). Among all deviant cases coverage with respect to the solution, we are looking for the case that most nearly approaches the ideal case located in the upper-right corner:

$$(3)\ S_{Dcovi} = \frac{Y_i - X_i}{X_i}$$

Figure 6 contains all cases that are members of row 7 and presents formula scores for all cases in zone 1. Poland and the Czech Republic both have a membership of 0.55 in the row and outcome and thus achieve a score of 0 according to our formula.

Figure 6: *XY* plot and formula scores for members of truth table row *CONSDEM*SEMIPRES*NEWDEM*~RIGCONST*



Note: If cases have identical scores, select case with higher membership in *X*

5. Generalization of case study insights

Unless case studies are performed in all relevant cases at hand, the challenge of establishing the scope for the generalization of the causal inferences arises. The key question is: how far do the insights gained through within-case analysis extend: to no other case?To a subset of all cases?Or to all cases in the population?[45] Surprisingly, this arguably crucial issue is largely neglected in the general multi-method literature(Kühn and Rohlfing 2010). So far, set-theoretic MMR is no exception to this, which is particularly problematic. On the one hand, QCA works on populations of cases that, by definition, are comprised of causally homogeneous cases (Ragin 2006: 635-637). At the same time, one of QCA's features is carving out *equifinality*, i.e., *diversity* among the cases under study (Ragin 2000: chap. 2). Cases of the same type are *qualitatively* identical and cases belonging to different types are *qualitatively* different. We claim that the scope of causal inference is limited to all cases of the same type.[46] Findings from the study of one, say, typical case, travel to all other typical cases of the same term. Likewise, findings from one deviant case coverage travel to all other deviant cases coverage of the same row, but not beyond this row.

For illustration, consider a typical case for the term *CONSDEM*~SEMIPRES*. The within-case analysis of Latvia had delivered evidence for the mechanism 'high-quality discourse' (*DISC*).We generalize our finding to all other typical cases of *CONSDEM*~SEMIPRES*– Bulgaria, Estonia, Germany, Hungary, and Macedonia - without doing process tracing in them. The rationale is that a mechanism starts with, and is triggered by, the sufficient term. When typical cases share the same sufficient term, they should also share the same mechanism (Machamer, Darden, and Craver 2000: 3). Put the other way around: if we believe that different mechanisms are operative in typical cases belonging to the same term, from where should these

[45]Schneider and Rohlfing (2013) briefly address this topic but limit their answer to typical cases.

[46] Since sets establish categorical similarities and differences, the literature on types and typologies is instructive here (Collier, LaPorte, and Seawright 2012; Sartori 1970).

different mechanisms be derived? The same sufficient term cannot give rise to different mechanisms, meaning that the assumption of diversity on the level of mechanisms implicitly presumes that the QCA solution is misspecified, rendering it futile to take it as a starting point for meaningful case selection in the first place.[47] The mechanism discerned in the examined typical case is thus assumed to be operative in all typical cases (Machamer, Darden, and Craver 2000: 3)[48]

The same logic applies to the two types of deviant cases. Deviant cases consistency share the same qualitative membership in the term and non-membership in the outcome. Here, we argue the most reasonable starting assumption is that all of them are non-members of the outcome due to the same missing INUS condition, which, in turn, is the reason that the mechanism known from typical cases is not operative in this type of deviant case. Likewise, all deviant cases coverage belong to the same truth table row. It therefore is plausible that we can assume that it is membership in the same omitted condition that accounts for the deviance of all of them.

Needless to say, generalization along these lines can be wrong - which is exactly the challenge of generalizing causal inferences (Lucas 2003). But the central question is not whether generalizations are right or wrong because we cannot answer this unless we have studied all cases - which in turn would mean that we no longer have to generalize. The question is: what is the most straightforward generalization *assumption* in the context of QCA-based case studies? After we have delineated the overall population of comparable cases and identified diversity within this population(see Ragin 2000: chap. 2; Strijbis 2013), the natural default assumption is that we have causal homogeneity among cases that are of the same type and belong to the same term.

[47] The only feasible explanation unrelated to model misspecification is inherent indeterminacy according to which the same term sometimes triggers one mechanism and, at other times, triggers another mechanism. While this is a possible assumption, our starting assumption is that the same term triggers the same mechanism.

[48]See Falleti and Lynch {, 2009 #4328} on context and mechanisms, although they do not explicitly cast their argument in a set-relational context.

It is important to note that the generalization assumption can be subject to empirical scrutiny with regard to deviant cases consistency and coverage.[49] If the same omitted INUS condition we identified in case studies is missing in all deviant cases consistency, then the inclusion of this omitted condition will turn all deviant cases in kind into individually irrelevant cases. If there still are deviant cases consistency after having added the INUS condition, then we have reason to believe that deviant cases consistency are causally heterogeneous and that another INUS condition has been omitted from the model (assuming that non-model related reasons for deviance can be ruled out as sources of the remaining puzzling cases). Correspondingly, the assumption of causal homogeneity among all deviant cases coverage belonging to the same truth table row must be refuted if some of them fail to turn into typical cases once an omitted term has been added to the model.

6. Conclusion

Qualitative Comparative Analysis is a cross-case method that works best in combination with the intimate knowledge of cases. While there is a broad body of literature on the role and value of case studies prior to performing a QCA(e.g., Rihoux and Lobe 2009), the discussion about how to perform case studies on the basis of a QCA solution is still in its infancy. Our paper makes four contributions to the emerging methodological literature on set-relational MMR. First, we spelled out the role of counterfactuals in the analysis of three different types of cases and elaborated on the relation of these case-based counterfactuals and those made when deriving the intermediate and parsimonious solution with QCA, Second, we formulated mathematical formulas for identifying the best available case for within-case studies for three different types. Third, we specified the scope of generalization of within-case inferences. And, fourth, we detailed the proper sequence in

[49] See Rohlfing and Schneider (2013) for an elaboration of this argument in analyses of necessity.

which the three types of cases should be approached for getting the most out of their empirical analysis. All our arguments, while developed based on fsQCA, extend to multi-value QCA (mvQCA) and crisp-set QCA, except for the formulas for formalized case selection, which can only be applied to fuzzy sets.

We envisage several avenues for further research on set-theoretic MMR. There are similarities, but also important differences between case studies based on regression results on one hand and set-relational results on the other.[50]For example, an important matter concerns the nature and number of different types of cases that are available for within-case analysis, as we have more types available after a QCA. This difference is the direct result of the important difference between necessary and sufficient causes, which is at the core of set-theoretic MMR (Ragin and Schneider 2011: 159). Another difference concerns the basis for case selection. In set-theoretic MMR, we choose cases based on their membership in a term or truth table row and in the outcome. In regression-based MMR, the only tool for case selection is a case's residual, i.e., the difference between its predicted score on the outcome and the actual score. We deem it interesting to explore whether this is a genuine difference between set-theoretic and regression-based MMR, or whether the latter actually could mimic the former. In light of the evolving field of multi-method analyses with its statistical and set-relational branches, a worthwhile avenue for future research would be to explore further commonalities and differences. Last but not least, this paper has focused on the principles of single case studies, which, by their very definition, must rely on counterfactuals for drawing causal inference. Future work should extend the perspective to comparative case studies that substitute counterfactuals with empirical comparisons.

[50]See Vis (2012) on the relation between results derived from a cross-case fsQCA and regression analysis.

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