FUZZY SET APPROACHES TO THE STUDY OF GLOBAL CIVIL SOCIETY

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Introduction

This chapter builds on the comparative-historical approach to studying global civil society presented in *Global Civil Society 2005/6* (Anheier and Katz 2005). There, we suggested this approach in order to remedy some of the methodological problems that plague the study of transnational aspects and processes: the complexity of the phenomena involved, the limited number of cases available for analysis, the paucity of data in terms of coverage and quality, and the tendency of conventional statistical methods to emphasise the outcome rather than the process of causality.

Drawing on the work of Ragin (1987) and others, we suggested that the qualitative comparative method (QCA) and the basic set theory it builds on could be a useful tool for the analysis of global civil society. Yet QCA has its limitations in the sense that it treats social phenomena as dichotomous, meaning that in QCA a case either demonstrates or doesn't demonstrate a certain trait, and the methodology is not sensitive to subtle differences in the strength of the trait between cases. This could be seen as reductionism: classifying manifestations of global civil society as dichotomous rather than gradual or continuous phenomena can result in loss of information and hence in measurement errors, which, ultimately, can limit theory testing and conceptual development. In response, fuzzy set approaches seek to overcome these limitations by applying set theory to non-dichotomous data. This chapter outlines the logic and procedures of fuzzy set QCA (fs/QCA), and illustrates its utility by analysing the necessary conditions for the globalisation of civil society.

Crisp and fuzzy sets[1]

As we outlined in *Global Civil Society 2005/6*, QCA uses Boolean algebra, which allows us to assess 'combinatorial complexity when comparing relatively small numbers of cases that involve multiple causal factors' (Anheier and Katz 2005: 290). It evaluates different combinations of causal factors leading to the presence or absence of a particular outcome. To recall the social forum example in Anheier and Katz (2005): The outcome 'social forum success' (with 1 = successful, and 0 = unsuccessful) could be caused by factors such as the presence of local leadership (1 = presence, 0 = absence); the degree of coordination with related causes (1 = presence, 0 = absence); and the availability of financial and human resources for organising and holding the forum (1 = presence, 0 = absence).

This approach assumes dichotomous outcome and causal factors, or 'crisp' sets, in the sense that membership in each is unequivocal and non-ambiguous: a particular case either shows the characteristics of set membership (and hence is given a score of 1) or it does not (and hence is given a score of 0). While crisp sets can uncover complex causal relationship among multiple causes and a specified outcome (see also Ragin 2004), the 'crisp' membership assumption can nonetheless be homogenising, even overly simplifying, and ultimately misses much of the diversity and causal complexity involved. Indeed, many phenomena and relations in global civil society are a matter of degree and cannot be forced into simple dichotomies (Anheier and Katz 2005: 293; generally see Ragin 1987; 2000).

By contrast, a fuzzy set approach allows for both different degrees of membership as well as dichotomous distinctions, thus capturing the inherent 'dual nature of diversity'[2]. In the social forum example above, presented more fully in Anheier and Katz (2005), cases (here: social forum locations) can vary: some may have stronger leadership or more resources than others. Fuzzy set approaches can take account of such variations in causal factors and outcomes.

Basic fuzzy set analysis

Clearly, a critical issue for fuzzy set approaches is defining scales or criteria that set the number of categories or degrees and their boundaries between 'a lot' of local leadership and 'no' local leadership, or between 'plenty' and 'no' resources, and so on. A first step in approaching the scaling issue is to look at the dual meaning of membership in fuzzy sets. Such sets exhibit both qualitative (that is, a case either is or is not a member in the set) and quantitative aspects (that is, the various degrees of membership ranging between 0 and 1). A simple fuzzy set can have a membership scale with only three values: 0, 1/2 and 1; it can also have more values, as would be the case for a stepwise scale of 0, 0.2, 0.4, 0.6, 0.8 and 1; and it can even approach a continuous scale with values ranging from 0.00, 0.01, ..., 0.99 to 1.00.

In practice, determining fuzzy set membership is based on a correspondence between theoretical concepts and data. For example, if a theory suggests intermediate positions between the two extreme qualitative states of full member and full non-member, we may proceed as follows, taking into account available empirical information: full set membership has a score of 1; strong, partial membership has a score close to 1 (for example, 0.75); membership scores of 0.5 indicate maximum ambiguity with cases 'neither in nor out' of the set; scores close to zero (such as 0.25) indicate weak membership in the set; and a score of 0 indicates full non-membership.

Setting and calibrating membership scores is a creative challenge for users of fuzzy set approaches. To appreciate this challenge, consider the meaning of a 'heap of sand' (Verkuilen 2005). How much sand constitutes a heap? Few people would say that a few grains of sand on a carpet constitute a heap, yet most would agree that a bucket of sand dumped in their living room is a heap. The problem is that locating the cut-off point between heap and not-heap is to some extent arbitrary, and involves interpretation. The translation of numerical variables into fuzzy set membership scores, therefore, requires theoretically informed decisions.

Next is the selection of cases for analysis. While case selection may be limited by data availability, theoretical rather than statistical considerations of representativeness are important. Specifically, cases should be selected with non-zero scores in the outcome set. For example, analysing the causes of generous welfare regimes, Ragin (2000: 290–5) selects developed nations that have at least some degree of 'welfare generosity'. Given the relatively small number of cases involved, all empirical observations rather than some probability sample would enter the actual analysis. More generally, given that selected cases are non-probability samples, Katz, Vom Hau and Mahoney (2005) suggest identifying cases from homogenous populations to help control for unknown contextual variations that may affect the relationship between causes and outcome.

With scales established and membership scores calculated for cases selected, the analysis proceeds by looking at the causal relationship between the outcome set and the sets of conditions, including combinations among the latter. This analysis begins with tests of necessity to determine which factors have to be present for the outcome to occur. Conditions found to be necessary are then compared with other causal conditions to evaluate different combinations that are sufficient for producing the outcome. As a result, the analysis reveals the various combinations of necessary and sufficient causes that form different paths leading to the outcome. In a similar fashion to QCA, sufficient combinations are then reduced using Boolean mathematics to create a parsimonious statement of the cause and effect relations involved. Let us look at some of these steps more closely.

Operations on fuzzy sets

Because fuzzy sets are represented by numerical values, they can be analysed using algebraic operations, the most common of which are negation, logical *AND*, logical *OR*, concentration, and dilation[3]. For negation, we subtract the case's fuzzy set score from 1: ~A = 1 – A (Ragin 2000: 172), where ~ indicates 'not' and A refers to a membership score in the fuzzy

1 *This chapter draws strongly on the work of Charles Ragin, and particularly on Fuzzy Set Social Science (Ragin, 2000), which is the definitive text for the methodology.*

2 *Ragin argues that there are two aspects to diversity exhibited by social phenomenon: (a) differences in kind, that is, the difference between two extremes, whether a social phenomenon does or does not exhibit the characteristic of interest. This is similar to crisp membership described above; and b) differences in degree, that is, differences between the categories that fall in the interval between the two extreme states. For a fuller discussion of diversity as it relates to fuzzy set methodology, see Ragin (2000).*

3 *In this brief overview, we are unable to deal with the last two operations that involve additions of quantitative modifiers to verbal constructs of fuzzy sets. For a full discussion, see Ragin (2000).*

set. It is important to keep in mind, however, that the negation of a fuzzy set means only the degree to which the case is not in a specific set A, and it does not indicate any membership degree in any opposing sets. For example, if the fuzzy set is 'rich' and the cases are individuals, then the negation of the membership scores in the set of 'rich' individuals does not indicate their score in the set of 'poor' individuals. To determine the membership scores in the set of 'poor' individuals requires a separate fuzzy set with its own scores.

Logical *AND* operations refer to joining two or more fuzzy sets, also known as compound sets or the intersection[4]. *AND* operations are ruled by the minimum of the two fuzzy set scores. For example, suppose a case has the following membership scores in two fuzzy sets: 'local leadership' with 0.65 and 'financial resources' with 0.35. The minimum rule states that the membership score in the combined set of 'local leadership *AND* financial resources' is the minimum of the two scores, that is, 0.35, because the higher value in one fuzzy set cannot compensate for lower values in another.

Logical *OR* operations also refer to joining two fuzzy sets, but indicate union rather than their intersection[5]. In this operation we take the maximum of the two scores. For example, for the two hypothetical fuzzy sets mentioned above, the membership score in 'local leadership *OR* financial resources' would be 0.65 because the score of the combined set would be at least as high as score in the set where membership is highest. The logical *AND* and *OR* operations also hold for any number of component fuzzy sets (that is, three, four or five components).

Necessary and sufficient causes

The difference between necessary and sufficient conditions is best introduced by the following hypothetical examples:

1. S = AC + BC means that condition C is necessary for S to occur but not sufficient in the sense that C needs the presence of either A or B in producing S.

2. S = AC shows that both A and C are necessary but not sufficient as they have to be co-present for the outcome S to occur.

3. S = A + BC indicates that A is sufficient but not necessary as the absence of A and the presence of BC can bring about the outcome S.

4. S = A states that A is both necessary and sufficient cause of S.

A first step in identifying necessary and sufficient conditions is to select cases that exhibit the outcome of interest and assess the presence of common conditions. Necessary causes are identified with the help of the subset principle. It states that when membership in the outcome is less than or equal to membership in the cause, then the cause can be considered a necessary condition for the outcome. The scores for necessary conditions set a ceiling on the degree of membership in the outcome (Ragin 2000: 218). For multiple causal conditions, the subset principle would apply to the intersection (minimum score) of the factor sets, which would then be compared with the membership scores in the outcome set.

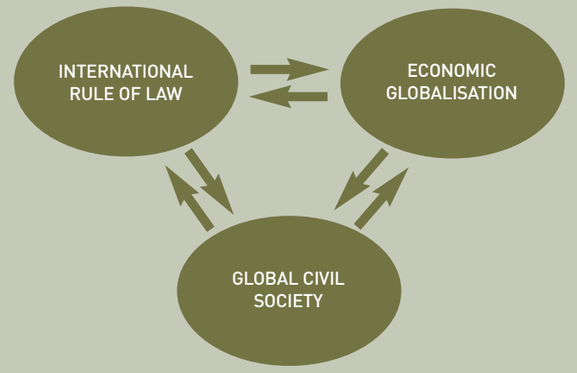
Like necessary conditions, sufficient conditions can also be expressed in the form of an arithmetic relationship: membership scores in causal condition should be less than or equal to membership scores in the outcome. That is, according to the subset principle, sufficient causal conditions are a subset of the outcome. Notice that this is the inverse to the rule for necessary conditions. In terms of research design, the study of sufficient conditions is also the inverse of the study of necessary conditions; instead of selecting cases based on the outcome, researchers select cases based on causal conditions, which are determined a priori.

Finally, if there are more than one causal combination with scores less than or equal to the outcome scores, the next step is to simplify the list and see whether any causal combinations are redundant according to the containment rule. This rule, based on Boolean minimisation, states that more complex casual expressions can be absorbed by less complex ones as along as all the elements that appear in the latter also appear in the former. In other words, the containment rule weeds out redundancies among conditions. The final step in fuzzy set analysis is to form a summary statement describing the causal combination (see Ragin 2000: 245).

*4 Logical 'and' operations are annotated as a multiplication and written as 'AB' or 'A*B' which is interpreted as A AND B or the intersection of A and B.*

5 Logical 'or' operations are annotated as an addition and written as 'A + B' which is interpreted as A OR B or the union of A and B.

Figure M1: Global civil society and globalisation



Applying the method: the necessary conditions of global civil society

To demonstrate the utility of fuzzy set approaches for the study of global civil society, we offer a brief analysis of the 'causal chemistry' of phenomena linked to the development of global civil society. Since space does not permit a full illustration of a fuzzy set application, we concentrate on an admittedly rather simplistic analysis of the necessary conditions of global civil society development.

Fuzzy set analysis is strongly guided by theory, and requires clear and well-formulated theoretical argument for testing causal statements. For the following illustration, we return to the model presented in *Global Civil Society 2002* (Anheier and Stares 2002). This model situates global civil society in the context of two other complexes: economic globalisation (finance, production, trade) and international law (treaty ratification, human rights, and so on). Hence, there is a threefold connection between global civil society, economic globalisation and the international rule of law, as shown in Figure M1.

Considering this theoretical model further, we hypothesise specific causal relationships among these three elements. One such hypothesis sees economic globalisation and the international rule of law as causal preconditions for the emergence of a globalised civil society at the country level. The integration of national civil society in a global civil society, as expressed in national involvement in international NGOs and the adoption of cosmopolitan values, would depend on open access to financial markets and trade, and on the acceptance of international laws, conventions and norms such as human rights. Together, these factors would provide a shared causal platform from which global civil society could emerge.

But are economic globalisation and the acceptance of the international rule of law indeed causal conditions for the development of global civil society? This question can be answered using a fuzzy set methodology. First, we assess whether economic globalisation and the acceptance of the international rule of law (the two conditions) are necessary for the emergence of global civil society (the outcome). We can then determine whether in all the cases where a globalised civil society has emerged we also find both a globalised economy and an acceptance of international law. Next, we would inquire whether the conditions are sufficient for the emergence of the outcome, that is, whether in all cases where these conditions are met global civil society has emerged.

Determining fuzzy set membership

Fuzzy set analysis begins with the selection of indicators. For the global civil society set, we use the Global Civil Society Index (GCSI) developed by Anheier

Table M1: Defining membership for fuzzy set 'countries accepting international rule of law'

Raw scores of international rule of law source data	Verbal fuzzy membership score label	Fuzzy membership score
Low on all 4 indices	Fully out	0
Low on 3 indices and medium on 1 index	Almost fully out	0.125
Low or medium on all 4 indices	Mostly out	0.25
Low or medium on 3 indices and high or very high on 1 index	More or less out	0.375
Low or medium on 2 indices and high or very high on 2 indices	Neither in nor out	0.5
High or very high on 3 indices and low or medium on 1 index	More or less in	0.625
High or very high on all 4 indices	Mostly in	0.75
Very high on 3 indices and high on 1 index	Almost fully in	0.875
Very high on all 4 indices	Fully in	1

and Stares (2002). This index comprises variables measuring organisational and individual aspects of civil society, such as participation, cosmopolitan values and membership in international organisations. For the set 'economic globalisation' we use the index developed by the Swiss Institute for Business Cycle Research (URL), which incorporates on the one hand data on actual flows, including trade, foreign direct and portfolio investment, and income payments to foreign nationals, and on the other financial and trade restrictions such as import barriers, tariffs, taxes on international trade and capital account restrictions (Dreher 2006). For the set 'acceptance of an international rule of law' we took into account both intent and action by using (a) data on the number of human rights, humanitarian and environmental international treaties ratified, and (b) data on actual human rights practices.

Empirically, these indicators determine the membership scores of countries in each of the three sets in the model – the set of economically globalised nations, the set of countries accepting the international rule of law, and the set of countries with a globalised civil society. Determining fuzzy set membership scores is a crucial step. In this case, we had to determine three critical scores:

- full membership, represented by the score 1.0, to be assigned to cases that are undoubtedly and fully members in the set
- full non-membership, represented by the score of 0, for cases that are clearly not members in the set
- maximum ambiguity, where cases are neither clearly in nor out of the set.

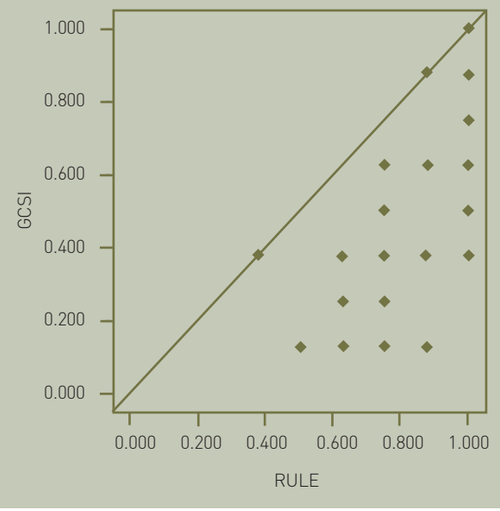
For space reasons, we illustrate the assignment of membership scores only for the condition 'acceptance of the international rule of law'. Four variables from two sources were used to compile fuzzy membership scores for this set. The first two were the number of humanitarian and human rights treaties and the number of environmental treaties ratified by each country. The second source used was the CIRI Human Rights Data Project (CIRI URLa), which produces indices of human rights violations from the human rights reports of the US Department of State and Amnesty International. The two indices used here are CIRI's Physical Integrity Rights Index (Cingranelli and Richards 1999), which measures actual human rights violations, and Empowerment Rights Index (Richards, Gelleny and Sacko 2001), which measures governments' respect for various political, economic and social rights (short descriptions of these two indices are available on CIRI's website, CIRI URLb).

The raw scores for each of these indicators were grouped into four levels: low, medium, high and very high, and the combination of scores used to determine fuzzy set membership. As shown in Table M1, a country that scored low on all four indices is fully out of the set of countries accepting the international rule of law (no country in our data received this score), while a country that scored very high on all four indices is fully in the set of countries accepting the international rule of law. Countries that scored low or medium on two indices and high or very high on the other two were located at the point of complete ambiguity – neither in nor out of the set. The level of detail of the index scores yielded a 9-point scale, as Table M1 shows.

Table M2: Fuzzy set membership scores

Country	Global Civil Society Index	Economic globalisation	International rule of law
Argentina	0.125	0.625	0.75
Austria	0.625	0.875	0.75
Belgium	0.75	0.875	1
Bulgaria	0.125	0.625	0.625
Chile	0.125	0.625	0.75
Croatia	0.25	0.25	0.625
Czech Republic	0.5	0.875	0.75
Denmark	0.875	0.875	1
Estonia	0.25	0.875	0.75
Finland	0.75	0.875	1
France	0.625	0.875	0.875
Germany	0.375	0.875	1
Greece	0.375	0.75	1
Hungary	0.125	0.625	0.875
Iceland	0.875	0.875	0.875
Ireland	0.625	0.875	0.875
Italy	0.5	0.875	1
Latvia	0.25	0.875	0.75
Lithuania	0.125	0.75	0.75
Netherlands	0.875	0.875	1
Poland	0.125	0.375	0.75
Russian Federation	0.125	0.375	0.625
Slovakia	0.375	0.625	0.625
Slovenia	0.375	0.625	0.75
Spain	0.375	0.875	0.875
Sweden	1	0.875	1
Switzerland	0.625	0.875	1
Ukraine	0.125	0.375	0.5
United Kingdom	0.625	0.875	0.875
United States	0.375	0.875	0.375

Figure M2: Plot of GCSI against RULE



We applied the same approach to constructing fuzzy sets for 'economic globalisation' and 'global civil society'. Table M2 shows the resulting scores for each country. These scores provide the input for the actual fuzzy set analysis, that is, for establishing whether economic globalisation and the international rule of law are necessary and/or sufficient conditions for global civil society. Note that one country, Mexico, scored 0 on the outcome, and was therefore excluded from further analysis.

Analysing necessary conditions

As mentioned above, determining necessary conditions is based on the subset principle. If set A is fully contained in set B, A is a subset of B, and membership in set B is a condition for membership in set A. In other words, all cases of set A must also be cases of set B, and membership of set B is necessary for membership of subset A.

Are economic globalisation and the international rule of law necessary conditions for global civil society? Following the principles described above, we need to compare the membership scores of the cases in the outcome set (GCSI) with those in the condition sets (ECON and RULE). If membership scores in the outcome set are consistently lower than membership scores in each of the conditional sets, we can conclude that the answer to this question is 'yes'.

It is useful to present this as a bi-plot, in which cases are plotted as a function of their membership scores in the outcome set (Y axis) and condition sets (X axis). If indeed the outcome is a subset of the conditions, all the cases will be on or below the diagonal of the plot. As is shown in Figure M2, GCSI is indeed a subset of RULE. This can be interpreted as a confirmation of the hypothesis that an acceptance of the international rule of law is required for the emergence of a globalised civil society.

By contrast, the relationship between economic globalisation and global civil society seems more complex. As is shown in Figure M3a, in one case (Sweden) membership score in the fuzzy set GCSI is higher than in the fuzzy set ECON. In light of this one aberrant case, are we to conclude that economic globalisation is not a necessary condition for global civil society? From a strict set-theoretical viewpoint, we should. However, Ragin (2000: 223–6) suggests two possible ways to resolve this problem. The first addresses measurement and translation imprecision. Aberrant cases may be caused by measurement errors or by imperfect translation of data into fuzzy set membership. If the accuracy of data is an issue, adjustment factors can be introduced to correct for measurement biases.

Figure M3a: Plot of GCSI against ECON

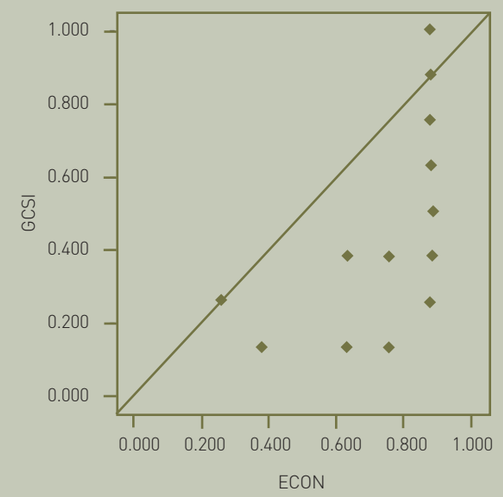
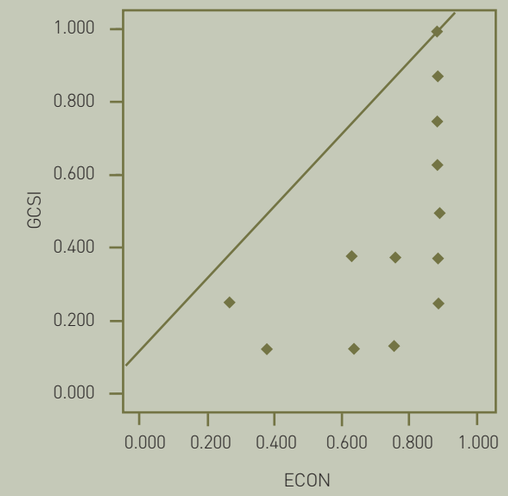


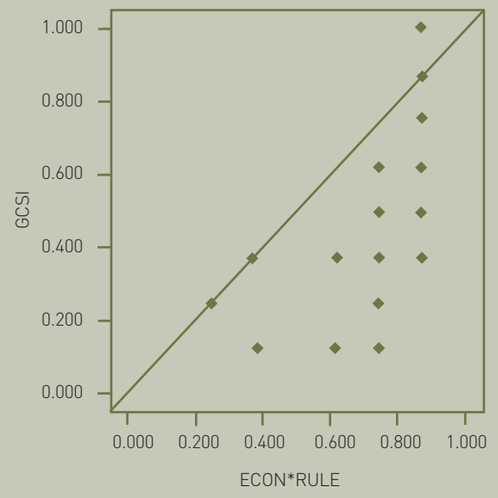
Figure M3b: Plot of GCSI against ECON with adjustment factor



Hence, to substitute for better measures, one makes the criteria for evaluating the subset relationship more lenient. By moving the diagonal upwards, as shown in Figure M3b, 'near misses' are no longer a violation of necessity.

The second cause of aberrant cases or near misses may be the randomness inherent in social science data. Even with near perfect measures, many effects are outside specified models and difficult to control and account for. One way to address this problem is to set probabilistic rather than absolute criteria for necessity. For example, a benchmark criterion of 80

Figure M4: Plot of GCSI against intersection of ECON and RULE



per cent means that necessity will be accepted if 80 per cent of the cases support it, with a confidence level of 95 per cent (or a .05 significance level). In our case such a benchmark leads to the conclusion that the hypothesis that economic globalisation is a necessary condition for global civil society is supported: within a 95 per cent confidence level, 29 out of 30 of the cases indicate necessity.

So far we have seen that economic globalisation and international rule of law are each necessary conditions for global civil society. But is the combination of these two conditions also a necessary condition? Does the emergence of global civil society require both the acceptance of international norms and economic interconnectedness? To answer this question, we need to compare the membership scores of cases in the GCSI set with membership scores in the set created by the intersection of these two sets: ECON and RULE. As mentioned above, the set intersection is applied by taking the minimum membership score of the case in the original sets. The result is shown in Figure M4.

Again, the 'near miss' case of Sweden doesn't prevent us from concluding that necessity is supported with an 80 per cent benchmark and 95 per cent confidence level. It would seem, therefore, that it takes a combination of economic globalisation and the international rule of law for global civil society to emerge, and we can alter our theoretical model to depict this relationship (Figure M5): global civil society cannot emerge without at least some level of economic globalisation and some level of adherence to the international rule of law.

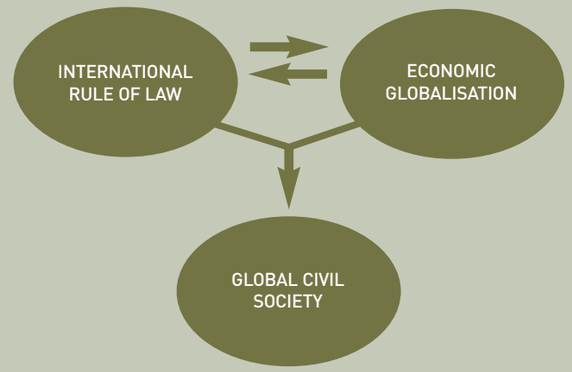
Analysing causal complexity - testing sufficient conditions

Analysing causal complexity requires knowing not only under what conditions the outcome occurs but also the different causal combinations involved. With this in mind, the next steps in fuzzy set analysis are to determine which combinations of factors are sufficient conditions and which combinations explain cases that score more highly than others in the outcome set.

An important difference between sufficient and necessary causes is that the former must logically involve a combination of causal conditions, not just one. The number of causal combinations is guided by the formula $3^k - 1$, where k is the number of dichotomies in the property space. In our example, there are eight possible causal combinations to test:

1. ECON
2. RULE
3. ~ECON
4. ~RULE
5. ECON*RULE
6. ECON*~RULE
7. ~ECON*RULE
8. ~ECON*~RULE

Figure M5: Necessary conditions for global civil society



The case scores for each combination are determined using the operations on fuzzy sets outlined above, that is, subtracting from 1 for negation, and finding the minimum for intersection. Once this is done, we compare the scores for each causal condition with the scores for the outcome, and choose the combinations that are subsets of the outcome set by finding combinations with scores less than or equal to the outcome scores. Note that in the analysis of sufficiency, the logic of the subset principle is the reverse of that in the necessity test.

If there are two or more sufficient causal combinations, the next step is to simplify the list and establish whether any causal combinations are redundant according to the containment rule, in a similar fashion to what we demonstrated in *Global Civil Society 2005/6* (Anheier and Katz 2005). The end result is a succinct statement of the combinatorial relationship between causes and outcome. Space limitations, however, prevent us from presenting this part of the analysis, but the general thrust of the fuzzy set approach should have become clear.

Conclusion

The purpose of this chapter is to explore further the applicability of comparative historical research methods, and particularly fuzzy set approaches, for examining aspects of global civil society. In this chapter we have only scratched the surface of what is a complex yet very promising analytical approach in social research. Further work could incorporate other factors that presumably affect the emergence of global civil society, such as regime type, economic development and availability of resources. It would be beneficial to complete the analysis, in particular pinpointing both 'necessity' and 'sufficiency' factors in an effort to unveil the full 'causal chemistry' of global civil society.

However, fuzzy set approaches are not suitable for all research questions. For some topics, other techniques are more appropriate; for example, large-N studies concerned with the 'effects of a cause' rather than the 'causes of an effect', would benefit from the application of regression models (Katz, Vom Hau and Mahoney 2005: 569). Moreover, using a fuzzy set analysis requires a well-grounded theoretical basis to inform the relevant variables (or sets) included in the analysis, and the expected causal relationships in terms of conditions and outcomes. Thus, the 'property space' and the variables included in the analysis are theoretically derived. Unfortunately, many areas of global civil society research lack the theoretical basis for establishing the property space for the kind of analysis proposed here.

Nonetheless, we hope that this brief illustration has highlighted the benefits of applying fuzzy set qualitative comparative methods to the study of global civil society. We hope that scholars of global civil society will consider adding this method to their repertoire, taking advantage of its unique approach to conceptualising, measuring and analysing social phenomena. As a result, we should see an improved understanding of the causal connections of global civil society and its many manifestations.

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