Exploring the Implications of Fuzzy-set Analysis Method in Social Science: Beyond the Border of Qualitative and Quantitative Research Methodologies

Taewook Huh*

This study explores the implications of Fuzzy-set Analysis method in social science, which combines a case-based qualitative method with a variable-driven quantitative method, and look at social diversity through comparative studies. The Fussy-set Analysis method as OCA (gualitative comparative analysis) can deal with existing case studies and intermediate cases that regression analysis can not address (15~50 cases). It consists of Fussy-set Multiple Conjunctural Analysis and Fussy-set Ideal Type Analysis. The former defines the relationship between cause and effect as a necessary condition or a sufficient condition, through the technical processes: 'Calibration', 'Operation', 'Evaluating set relations' and 'Reduction'. The latter analyzes the degree of belonging to each ideal type and the direction of the time series change by converting to the fuzzy membership score of continuous value between 0 and 1. In short, the fuzzy set analysis will allow active penetration into the areas covered by the variable-centric approach. It can be an alternative to the blind spot that the existing methodologies could not deal with and at the same time it can overcome these weaknesses.

I Key words I

Fuzzy-set Analysis, Fussy-set Multiple Conjunctural Analysis, Fussy-set Ideal Type Analysis, QCA

^{*} KAIST 문술미래전략대학원, 연구조교수

I. Introduction: Methodological Differences

The development of qualitative research and quantitative research methodologies in social sciences and the tension between the both sides have been very diverse. In fact, although qualitative research methodology is widely evolved and used in social science research, there are no single, unified approaches, but rather various definitions and practices. Broadly speaking, however, it can be said that qualitative research covers a wide range of approaches on "what there is to know about the social world and how to find out about it" (Snape and Spencer 2003: 22). As Denzin and Lincoln go on to say, qualitative research aims to provide "an in-depth and interpreted understanding of the social world, by learning about people's social and material circumstances, their experiences, perspectives and histories" (2000: 3-5).

Qualitative research consists of an aggregate of interpretative inquiries, applying semiotics, narrative, content, discourse, archive, and even statistical analysis, which empowers researchers to adopt multi-theoretical paradigms including constructivism, feminism, and ethnic study as a research method and strategy (Leeh, 2006). The suggestion here is that the qualitative researcher is able to deal with a range of problems by using a variety of research methods. The focus of qualitative research is characterised by trying to describe the holistic view or the complete picture. Its theories and hypotheses, on the basis of both inductive and deductive methods, seek to discover, through collected data, how people perceive their environment in a 'subjective' manner (Miller and Yang, 2007).

On the one hand, several significant philosophical debates and assumptions are raised by the use of qualitative research, for example, ontology, the nature of reality; epistemology, how the researcher knows the reality; and axiology, the role of 'values' in the research. According to Snape and Spencer (2003: 22), a key ontological debate concerns "whether there is a captive social reality and how it should be constructed on which there are three distinct positions" - realism, materialism and idealism. In regard to epistemology, there are two opposing stances. On one side there is the positivism, which "holds that methods of the natural sciences are appropriate for social enquiry" and on the other side, there is interpretivism, which "claims that natural science methods are not appropriate for social investigation because the social world is not governed by regularities that hold law-like properties" (Snape and Spencer, 2003: 23). In general, qualitative research is associated with interpretivism. Based on this epistemological belief or assumption, it is maintained by some that qualitative researchers should "get as close as possible to the participants being studied" (Creswell, 2007: 18). With respect to the axiological assumption, qualitative research is characterised by the value-laden nature of the research and, accordingly, is influenced by existing biases, which should be taken into account by qualitative researchers (Creswell, 2007).

These differences in philosophical orientation and rationale are embedded in both the contrasting methodologies - quantitative

research and qualitative research. In terms of epistemology, the former is essentially based on positivism and the latter is on the basis of interpretivism. Quantitative research assumes that it is possible to conduct objective research since objective reality exists, but qualitative research asserts the necessity of holistic research because there is no reality that can accurately generalized from a truly objective position. In respect to research aims, the former seeks to discover general principles and rules by analysing the causal relationship or correlation between variables. In contrast, the latter aims to interpret a specific circumstance or understand a range of different meanings. In this sense, while the quantitative method mainly uses probability sampling methods, requiring a number of samples with representativeness, the qualitative one, in general, adopts non-probability sampling methods, researching a few samples in depth. Finally, while the former pays attention to the generalisation of research results, the latter applies the research result to the particular circumstances, without trying to generalize it.

Considering the above arguments, this paper explores the implications of Fuzzy-set Analysis method in social sciences, which is structured as follows: in section 2, it discusses the theoretical rationale of Fussy-set Analysis, combining the border of qualitative and quantitative methodologies. In section 3, it explains the features and process of Fussy-set Analysis including Fussy-set multiple Conjunctural Analysis and Fussy-set Ideal Type Analysis, suggesting examples of Fussy-set Analysis applied papers. Finally, in section 4, it presents the implications and limitations of applying

Fussy-set Analysis in social sciences.

II. The Rationale of Fussy-set Analysis: Beyond the Methodological Border

The Fuzzy-set Analysis(methodology) is a special form of case study method as Qualitative Comparative Analysis (QCA) suggested by Zadeh from the University of Berkeley in 1965, and it has been used in diverse ways by scholars such as Ragin and Kvist in application to Social Sciences (Ragin, 1987; 1994; Choi, 2009; Shneider, et al, 2016). Fuzzy-set analysis is an improved version of the method from Qualitative Comparative Analysis (Ragin, 2000; 2008) that previously has been used in Social Sciences. Going beyond the permission of the existing traditional two membership scores, 1 or 0, by using crisp set/set theory, utilization of fuzzy set which has various membership scores between 0 and 1 can present not only the partial memberships but also the difference of the degree.

Specifically, fuzzy-set analysis has a set of major advantages. First, through exercising fuzzy-set methodology, disadvantages of case-oriented study (qualitative method) and variable-oriented study (quantitative method) can be overcome. It can be said that case-oriented analysis deals with a particular phenomenon in depth, whilst quantity-oriented analysis puts its emphasis on generalities of various cases by using variables (Ragin, 1987; 2000).

Fuzzy-set analysis categorizes cases by a combined method of two strategies that variable-oriented quantitative methodology and qualitative case study take, and it distinguishes itself from the existing analysis/methodology by examining social diversity through comparative study (Choi, 2009; Ragin, 2000). Second, due to this property, fuzzy-set analysis enables dealing of the midium-range case studies (15-50 cases) that comparative case analysis and regression analysis, could not address despite being substantial subjects to analysis, and makes middle-class comparative analysis possible (Ragin, 2000; Choi, 2009). Moreover, it is also used in analyzing joint causal relations by paying due consideration to interactive effects between each quality in a given case (Choi, 2009; Shneider, et al, 2016).

Third, it can explain diverse social phenomena. Although a great number of social scientists confront situations of analyzing complicated social phenomenon, in practical analysis it seems there have been many cases where they simply categorize the social phenomenon in dichotomy of 0 and 1 (examples; public sector and private sector, national and international politics, comparing high and low civil society capacity, etc.) (Ragin, 2000; Rihoux and Ragin, 2008). Fuzzy-set analysis overcomes this dichotomy method of 0 and 1 that have been used in many previous studies by enabling representation of various degrees between the 0 and 1, which minimizes the loss of information in analysis (Choi, 2009; Rihoux and Ragin, 2008).

Fourth, it enables a more theoretical approach to categorization

of types. Many researchers have been using quantitative statistic methods such as cluster analysis to categorize types (Gough, 2001; 2016; Bambra, 2004). While these types are confronted by criticism that they are categorized by arbitrary interpretation of the researchers, however, the fuzzy-set analysis determines the number of memberships by categorization standards that consist the ideal type extracted under theoretical background (Katz et al., 2006; Choi, 2009). Accordingly, many recent studies are applying fuzzy-set analysis to categorizing types (Yang and Jung, 2012; Seok, 2014). From a comprehensive perspective, fuzzy-set analysis has advantages of satisfying diversity the existing analytic methods have struggled to meet because it deals with middle-range cases, and on being capable of categorizing types under theoretical background. These properties of Fuzzy Set Theory serve as a useful tool in the analysis of civil society organizations that have general and undistinctive activity range and characteristics of an organizational interior (Katz et al., 2006).

III. The Features and Process of Fussy-set Analysis

1. Fussy-set Multiple Conjunctural Analysis

In the causal relationship of cause and effect (outcome) conducted in the existing quantitative analysis, the results did not perfectly correspond according to whether there was a cause or not. That is, there was the point during which it was difficult to

distinguish correlation and cause and effect (outcome). However, the Fussy-set Multiple Conjunctural Analysis, which defines the relationship between cause and effect as a necessary condition or a sufficient condition, has the advantage of overcoming such a problem. Other than that, as mentioned previously, it can be a powerful tool when it comes to analyzing the causal complexities in intermediate level case studies.

Contrary to the existing multiple regressions of quantitative method, the methodologies by the Fussy-set Multiple Conjunctural Analysis are mainly divided into the following three. First, the problems of degree of freedom and multi-collinearity, that may occur due to a small number of cases in the existing regression analyses, can be overcome. In order to secure the necessary statistical significance for researching the causality of dependent variables and independent variables in regression analysis, there has to be a sample of thirty or more. In addition, the statistical degree of freedom problem and the multi-collinearity problem due to the correlation between independent variables and the linear model assumption may occur. However, the Fussy-set Multiple Analysis is able to analyze the combination of the reason variable conditions by targeting small number of cases. In other words, it has the advantage of being able to analyze the combination of causal conditions without having to use the assumption of the independence between variables and the linear relationship.

Second, Fuzzy-set/QCA is the analysis which combined quantitative analysis and qualitative analysis. It sets causal conditions and result

conditions by qualitatively considering cases and variables and derives logical effects (outcomes) by going through the process of conversion into quantitative data. Third, it has the strength of identifying causal relationship by variously integrating not only the unilineal effects by certain variables but also multiple causal conditions (Rihoux, 2006; Ragin, 2008).

In particular, the technical process of fuzzy-set can be divided into the four states: ① 'Calibration' ② 'Operation' ③ 'Evaluating Set Relations' and ④ 'Reduction' (Ragin, 2008).

'Calibration' refers to convert the origin of the index into fuzzy-set membership score. In the fuzzy set, the various term values between 0 and 1 are given the 'linguistic meaning' according to the properties of the theory and case. Examples of classifications related to this are shown in Table 1 below. In such fuzzy score conversion, it is possible to analyze to what type or set the corresponding cases belong to based on the set theory in fact. When the fuzzy-set analysis is focused only on this result, without distinction between the dependent variable and the explanatory (independent) variable, it is called 'fuzzy-set ideal type analysis' (described in the next sub-chapter). In general, as Ragin (2000; 2008) explained, the following three important anchors are selected: 'complete membership' (fuzzy score=0.95, maximum origin value), 'complete non-membership' (= 0.05, minimum origin value), and 'Crossover point' (= 0.5, median origin value).

Crisp set	Third Quartile Fuzzy-set	Quintile Fuzzy-set	Continuous Fuzzy-set
1=complete membership	1=complete membership	1=complete membership	1=complete membership
		.75=complete membership rather than non-complete	membership level shows complete rather than non-complete
	.5=neither complete or non-complete membership	.5 (crossover point)	.5 (crossover point)
		.25=non-complete membership rather than complete	membership level shows non-complete rather than complete
0=non-complete membership	0=non-complete membership	0=non-complete membership	0=non-complete membership

Table 1. Examples of Classifications of 'Calibration'

Sources: Ragin (2000).

'Operation' on fuzzy-sets, the second technical process of fuzzy-set multiple conjunctural analysis is characterized by the union set (AUB (A+B), logical or: : belongs to set A, belongs to set B, or both); the intersection set (A∩B (A * B), logical and: belongs to set A and belongs to set B); and the complementary set (~A (1-A): not belongs to set A). 'Evaluating Set Relations', the third technical process of fuzzy-set multiple conjunctural analysis consists of ① Consistency and Coverage (examining 'significance' and explaining "strength' between causal sets and outcome sets), ② Y-Consistency and N-Consistency ('benchmark proportion' examples: more often than not (.50), usually (.65), almost always (.80)), ③ Necessary Condition examination (outcome set(Y) fuzzy score≤causal set(X) fuzzy score), and ④ Sufficient Condition examination (outcome set(Y) fuzzy score). The final technical

process of fuzzy-set multiple conjunctural analysis, 'Reduction' is carried out to present a reduced set, when finally deciding arrangements of causal sets.

Table 2 below shows the both examples of the fuzzy-set multiple conjunctural analysis applied papers, including research aims, fuzzy-set analysis methods, and fuzzy-set analysis results. The two example papers cover the results produced through four technical processes: 'Calibration', 'Operation', 'Evaluating Set Relations', and 'Reduction'.

Title	Research Aims	Research Methods	Research Results
"Comparing the Green Political Economy of OECD Countries through the Fuzzy-set Analysis"	 To set up an empirical measurement framework of green state To compare 24 OECD countries' cases 	 Fuzzy-set multiple conjunctural analysis Outcome set: SDG Index Causal set: T,I,G,D,V,O,H 	 Reveals the arrangements of two causal sets SDG Index (Outcome)=T (envrelated taxation) I (envrelated innovation) G (GDP per capita) * D (democracy index) * V (env. governance) * O (social expenditure) G (GDP per capita) C (GDP per capita) * D (democracy index) * V(env. governance) * H(env. health) Total Coverage=0.675 Solution Consistency=0.980
"Analysis of Policy Factors Affecting Fertility Rate by Country: Fuzzy Set Analysis for OECD Countries"	 To analyze the combination of factors affecting the birth rate of each country in OECD countries including Korea To compare 19 OECD countries' cases 	 Fuzzy-set multiple conjunctural analysis Outcome set: fertility rate Causal set: taxation, education, housing, childcare, vacation, working hours 	 Cases of Norway, Sweden, and Danish countries contribute to housing, education, and taxation together with family reunification are contributing to the birth rate rather than raising the birth rate directly Education and housing sector are necessary and sufficient conditions to raise fertility rate

Table 2. Examples of Fuzzy-set Multiple Conjunctural Analysis Applied Papers

Sources: Huh (2018); Jung and Seo (2014).

2. Fussy-set Ideal Type Analysis

Fuzzy-set Ideal Type Analysis represented by fuzzy membership scores demonstrates by applying Fuzzy-set Theory how close the subject of analysis is that is converted into fuzzy sets (Kvist 1999; 2007). Through this process it analyzes degree of memberships of each category, translating the existing original data results into fuzzy-set membership scores. As the number of the sets is decided by the ideal type unlike the existing cluster analysis through Fuzzy-set Ideal Type Analysis which this research conveys, more systematic categorization and interpretation become available (Seok, 2014; Yang & Jung, 2012).

The criteria for interpretation of membership scores of Fuzzy-set Ideal Type Analysis drawn from a research is based on the one suggested by Ragin (2008). In particular, after researcheres converts the scores into Fuzzy-set score system through the calibrate function of STATA 12.0 (or QCA software), they measure the scores according to 3 qualitative anchors: 'fully in', 'fully out', and 'crossover point' as in the degree of the two. In other words, any score that is higher than the crossover point (0.5) is given strong membership (in the case the degree of full membership the given value possesses (FI: fully In or full membership) is higher than 95%(0.95)), and any score below is given low membership score (in the case the degree of full membership is not present (FO: fully out or full non membership) is lower than 5%(0.05)). Formula for calculating Degree of Membership Score in Fuzzy-set Idea Type Analysis is as following:

• Degree of Membership=exp(log odds) / (1+exp(log odds)

The degree of membership is generally calculated and interpreted by ① 'Principle of Negation', ② 'Minimum Principle', and ③ 'Maximum Principle'. For example, if a research sets the four category variables 'A', 'B', 'C', and 'D', the principle of negation enables setting up negative categories of 'a', 'b', 'c', and 'd' through '1-Fuzzy-set membership score of the applicable category'. Ideal types are determined by applying number of cases that each category variable can take, and a research postulates sixteen ideal type sets (high or low) based on the four category variables.

In addition, these sixteen ideal type sets are yielded and interpreted by the 'Minimum Principle' and the 'Maximum Principle' (Kvist, 1999; Yang & Jung, 2012). The 'Minimum Principle' states that it is the minimum value among the fuzzy-set scores drawn from the principle of the sixteen types of ideal type categorization that will be the fuzzy-set membership score of the respective categories; in other words, among the fuzzy scores of the four variables (A, B, C, D) that consist the corresponding category sets, the minimum value will be selected. For example, if the fuzzy score of A in Category 'A*B*C*D' appears to be the minimum value, the fuzzy-set membership score of Category 'A*B*C*D' will be denoted as the fuzzy score of 'A' itself. Moreover, the 'Maximum Principle' postulates that while the fuzzy-set membership score of cases can conclusively be presented by sixteen types of categories, one with the maximum value of the membership score will be the category for the corresponding area.

The below table describes the both examples of the fuzzy-set ideal type analysis applied papers, including research aims, fuzzy-set analysis methods, and fuzzy-set analysis results. The two example papers cover the results produced according to the three principles: 'principle of negation', 'minimum principle', and 'maximum principle'. For example, the Huh(2018)'s research reconstructs the result of "Korea Civic Action Index (CAI) Survey" and conduct the fuzzy set ideal type analysis. The measurement results of CAI of the civil society organizations in the metropolitan cities and provinces were compared and analyzed by the fuzzy membership. The research has important implications for the practical application of the quality of civil society by theoretically and contextually complementing the mixed results of the three categories of existing CAI ('civil mobility', 'sustainability', and 'environment adaptability') through the fuzzy set ideal type analysis.

Title	"Comparing the Capacity of Civil Society Organizations of Metropolitan Areas in S. Korea through the Fuzzy-set Analysis"
Research Aims	 To reconstruct the result of 'Korea Civic Action Index (CAI) Survey' To conduct the fuzzy set ideal type analysis
Research Methods	 Fuzzy-set ideal type analysis (16 metropolitan cities and provinces) 3 variables ('Civil Mobility'(CM), 'Sustainability'(SU), & 'Environment Adaptability'(EA)) and 8 types
Research Results	 The measurement results of CAI of the civil society organizations in the metropolitan cities and provinces were compared and analyzed by the fuzzy membership The CM*SU*EA type (Type I) that has the high degree of three categories of CAI (CM, SU, EA) includes Daegu Metropolitan City (fuzzy-set membership score of 0.605), Ulsan Metropolitan City(0.563), Jeju-do(0.535), and Jeollabuk-do(0.269). On the other hand, cm*su*ea type (Type VIII), with the low degree of the three categories of CAI, includes Busan Metropolitan City(0.836), Jeollanam-do(0.688), and Daeieon Metropolitan City(0.513).
Title	"Change and Continuity of the Western and Korean Welfare States: A Fuzzy-set Analysis"
Title Research Aims	 "Change and Continuity of the Western and Korean Welfare States: A Fuzzy-set Analysis" To explore the change and continuity of the western and korean welfare states focusing on the behavior of welfare states for new social risks
Title Research Aims Research Methods	 *Change and Continuity of the Western and Korean Welfare States: A Fuzzy-set Analysis" • To explore the change and continuity of the western and korean welfare states focusing on the behavior of welfare states for new social risks • Fuzzy-set ideal type analysis (20 OECD countries (Y1995-Y2007) • 3 variables ('Generosity'(G), 'Aggressiveness' (A), 'Family support' (F)) and 8 types

Table 3. Examples of Fuzzy-set Ideal Type Analysis Applied Papers

Sources: Huh (2018); Jung and Yang (2014).

IV. The Implications and Limitations of Applying Fussy-set Analysis

There are qualitative research methodologies and quantitative research methodologies in social science, and related theories and softwares have evolved together. However, the development of these research methodologies doe not seem to provide enough tools to solve all the questions that social scientists have. The fuzzy set analysis has an important implication as a methodology that is actively discussed and developed in social science to solve the blind spot of these research methodologies (Ragin, 2000; Choi, 2009; Shneider, et al, 2016).

In recent years, attempts have been made to increase cases within the fuzzy set analysis method itself - 'Large-N' (up to or more 100) (Ragin, 2008; Jung and Seo, 2014). The combination of quantitative regression and extended fuzzy set analysis opens up the possibility of various studies (Jung and Yang, 2014; Jung and Seo, 2014). For example, there is a high possibility that fuzzy-set such as research on 20 national organizations or public corporations, research on the performance of 35 companies, or comparative studies on 50 cities can be applied to more microscopic units (Choi, 2009; Jung and Yang, 2012).

However, many additional concerns and researches are required to expand the application to 'Large-N'. In principle, the fuzzy set analysis will allow active penetration into the areas covered by the variable-centric approach since the fuzzy-set is based on the ontological roots of case-centered methodology and criticizes assumptions about case homogeneity of variable-centric methods. Simply fuzzy-set research methodology is not an attempt to fill the blind spot of case/variable-centric methodology. On the other hand, the key question is whether it is possible for the developed methodology based on the complexity of the cases to cover 100 cases, or whether the fuzzy methodology that refers to the substantial knowledge and theoretical knowledge on each case as the most important precondition can handle 'Lare-N' effectively is a valid question (Choi, 2009; Yang and Jung, 2012). This dilemma will be lessened by the number of studies already being conducted by a large number of researchers, or by the fact that there are a certain number of shared index(indicators) and criteria by many researchers.

Meanwhile, the limitations of concrete methodological issues of fuzzy set can be seen. The most sensitive methodological issue is the process of converting an actual score to a fuzzy membership score. The most basic requirement is that researchers clarify this procedure transparently with theoretical and practical knowledge. Whether using a continuous fuzzy membership score or using a traditional set, this procedure can be very clear in some cases, but sometimes also in cases where it is not clear-cut. In this case, how much is set to 1 and how much is set as a cross-over point is a question that continues to exist even if it is converted into a fuzzy membership score, using a software. These limitations could be addressed when selecting original values (for 'Calibration') based on certified international and domestic index results, for example, ones developed by OECD and UN.

Therefore, the fuzzy-set analysis requires that a theoretical basis for the conversion process of fuzzy membership scores should be well established (Ragin, 2000; Choi, 2009; Huh, 2018). If this is not the case, it becomes difficult to deal with the criticism that it is arbitrary and subjective. Therefore, methodological techniques need to be developed after story-telling, which understands context and background, rather than mechanical analysis.

The fuzzy set methodology is currently beginning to be applied in social sciences and needs to be refined more theoretically or applied. Nevertheless, I think that it will be a research methodology that will be more noticeable in the future as it can be an alternative to the blind spot that the existing methodologies could not deal with and at the same time it can overcome these weaknesses.

References

- Bambra. C. (2004). The Worlds of Welfare: Illusory and Gender Blind?, Social Policy & Society, 3(3), 201-211
- Choi, Y. J. (2009). Social science method: fuzzy ideal center of analysis and factor analysis. Jeongbuhak Research, 15(2), 307-337.
- Creswell, J. W. (2007) Qualitative inquiry and research design: choosing among five traditions, Thousand Oaks: Sage Publications.
- Gough, I. (2001). Globalizatoin and regional welfare regimes: The east asian case. Global Social Policy, 1(2), 163-189.
- Gough, I. (2016). Welfare states and environmental states: a comparative analysis. Environmental Politics, 25(1), 24-47
- Huh, T. W. and Cho, H. J. (2018). Comparing the Green Political Economy of OECD Countries through the Fuzzy-set Analysis. Korea and the World Economy 2018 Conference XVII, 2018. June.
- Huh, T. W. and Cho, H. J. (2018). Comparing the Capacity of Civil Society Organizations of Metropolitan Areas in S. Korea through the Fuzzy-set Analysis, Seoul Studies, 19(2): 90-108.
- Jung, Y. R. and Seo, J. W. (2014) Analysis of Policy Factors Affecting Fertility Rate by Country: Fuzzy Set Analysis for OECD Countries. 2014 Summer Conference of the Korean Association for Policy Studies, 2014. July.
- Katz, H., Helmut K. A., and Marcus M. L. (2006). Fuzzy set approaches to the study of global civil society, Global Civil Society, 7, 186-96
- Kvist, J. (1999). Welfare reform in the Nordic countries in the 1990s: using fuzzy-set theory to assess conformity to ideal types, Journal of European Social Policy, 9(3), 231-252.
- Kvist, J. (2007). Fuzzy set ideal type analysis, Journal of Business Research, 60(5), 474-481.
- Leeh, D. K. (2006) Jiljeok Yeongu Bangbeoplon [Qualitative research methodology], Seoul: Kyoyuk Gwahaksa [Kyoyook Book].
- Miller, G. J. and Yang, K. (2007) Handbook of Research Methods in Public Administration, New York: CRC Press.

- Ragin, C. (1987) The Distinctiveness of Comparative Social Science, The Comparative method. Berkeley: University of California Press.
- Ragin, C. (1994) Introduction to qualitative comparative analysis. In Janoski,T. and Hicks, A. (eds.) The comparative political economy of the welfare state. 299-319, Cambridge: Cambridge University Press.
- Ragin, C. C. (2000). Fuzzy-set social science, University of Chicago Press: Chicago.
- Ragin, C. C. (2005). Case-Oriented Research and the Study of Social Action, in Democratization and political culture in comparative perspective: Festschrift für Dirk Berg-Schlosser.
- Ragin, C. C. (2008). Redesigning Social Inquiry Fuzzy Sets and Beyond, University of Chicago Press: Chicago.
- Rihoux, B. (2006). Qualitative Comparative Analysis(QCA) and Related Systematic Comparative Methods: Recent Advance and Remaining Challenges for Social Science Research. International Sociology, 21(5), 679-706.
- Rihoux, B. and Ragin, C. (eds.) 2008. Configurational comparative methods. Los Angeles, London, New Dehli, Singapore: Sage.
- Snape, D. and Spencer, L. (2003) The Foundation of Qualitative Research in J. Ritchie and J. Lewis (eds.), Qualitative research practice: a guide for social science students and researchers, London: Sage.
- Seok, J. E. (2014). Towards a Sustainable Welfare State: An Evaluation and Typology of OECD Countries Through the Fuzzy-set Ideal Types Analysis, Health and Social Welfare Review, 34(4), 5-35.
- Schneider, Carsten Q, and Rohlfing, I. (2016). Case studies nested in fuzzy-set QCA on sufficiency: formalizing case selection and causal inference, Sociological Methods &Research , 45(3), 526-568.
- Yang, J. J. and Jung, Y. R. (2012). An Empirical Research of the Underdevelopment of the Welfare State. Korean Political Science Review, 46(5), 79-97.

국문요약

사회과학에서 퍼지셋 분석 방법의 함의 탐구: 질적 및 양적연구 방법론의 경계를 넘어

허태욱

(KAIST 문술미래전략대학원, 연구조교수)

본 연구는 사회과학 분야에서 사례 중심의 질적연구방법과 변수 중심의 양적연구방법을 결합하고 비교연구를 통해 사회적 다양성을 살펴보는 퍼지셋(Fuzzy-set) 분석방법의 함의를 탐구한다. QCA (질적비교분석)로써 퍼지셋 분석방법은 기존 사례연구 및 회귀분석이 해결할 수 없는 중범위 사례(15~50개)를 다룰 수 있다. 퍼지셋 분석은 다중결합요인분석(Fussy-set Multiple Conjunctural Analysis)과 이상형 분석(Fussy-set Ideal Type Analysis)으로 구 성된다. 전자는 '측정'(calibration), '연산', '집합관계의 검증', '축약'의 4가지 기술적 과정 을 통해 원인과 결과의 관계를 필요조건 또는 충분조건으로 밝혀낸다. 후자는 0과 1 사이의 연속 값의 퍼지 점수(fuzzy membership score)로 변환하여 각 유형에 속하는 정도와 시계 열 변경 방향을 분석한다. 결론적으로, 퍼지셋 분석은 변수 중심 (양적)방법이 다루는 분야로 적극적인 확장과 침투가 가능할 것으로 예상된다. 또한, 기존의 방법론들의 사각지대에 대한 대안이 될 수 있으며 동시에 이들이 가지고 있던 약점들을 극복할 수 있다는 측면에서 향후 눈 여겨볼 연구방법론의 대안이 될 수 있을 것이다.

주제어: 퍼지셋 분석, 퍼지셋 다중결합요인분석, 퍼지셋 이상형 분석, 질적비교연구

논문신청일: 2018.07.10. 논문심사일: 2018.07.24. 게재확정일: 2018.08.21.