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Pathways for Overcoming Commitment Problems in the Transition from Intrastate Conflict to Peace: A Fuzzy-Set Qualitative Comparative Analysis

İbrahim Kumek
Ph.D., Department of Political Science and International Relations, İstanbul University, İstanbul
E-Mail: ibrahim.kumek@ogr.iu.edu.tr
Orcid: 0000-0003-2096-159X

Hasan Duran
Associate Professor, Department of Political Science and International Relations, İstanbul University, İstanbul
E-Mail: hasan.duran@istanbul.edu.tr
Orcid: 0000-0001-5328-9918

Aylin Ece Çiçek
Assistant Professor, Department of Political Science and International Relations, İstanbul University, İstanbul
E-Mail: aylin.cicek@istanbul.edu.tr
Orcid: 0000-0002-9606-509X

Abstract

This article examines why some intrastate conflicts that end with comprehensive peace agreements lead to lasting peace, while others relapse into conflict. It focuses on the design and implementation of civil war peace agreements by formally evaluating a theoretical framework grounded in the bargaining model of war and credible commitment mechanisms. Using fuzzy-set qualitative comparative analysis, the study explores the conditions that facilitate successful transitions from war to peace. Five explanatory conditions are identified: power-sharing, transitional justice, transitional reform, international assistance, and the implementation process. The analysis compares thirty-four peace agreement cases between 1989 and 2012, drawing on data from numerous sources. The findings underscore the significance of fear-reducing, cost-increasing, and confidence-building mechanisms, suggesting the need to reassess existing theoretical frameworks. The study also compares five typical and three individually irrelevant cases to test the properties that link specific sufficient configurations to the outcome.

Keywords: civil war, peace agreements, post-conflict transitions, peacebuilding, fs/QCA

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Introduction

Intrastate conflicts pose a significant threat to global human security due to their profound impact on social, political, economic, and cultural aspects of life. Compared to other types of conflicts, intrastate conflicts are often more intense and widespread. Many regions worldwide have experienced prolonged internal violence, particularly since the end of the Cold War (Pettersson et al. 2021). Even comprehensive peace agreements do not guarantee the immediate restoration of order, and the risk of renewed conflict remains high in the post-conflict period.

This article investigates why some intrastate conflicts resolved through comprehensive peace agreements lead to lasting peace, while others relapse into violence. As an exploratory and descriptive study, it seeks to identify the conditions enabling successful transitions from conflict to peace, without establishing direct causal relationships. Previous research has predominantly focused on specific themes such as power-sharing, third-party guarantees, and security sector reforms, using statistical methods or qualitative case studies (Stedman, Rothchild and Cousens 2002; Hartzell and Hoddie 2003, 2007; Fortna 2003, 2004; Quinn, Mason and Gurses 2007; Bekoe 2008; Westendorf 2015). This study, however, employs a set-theoretic multi-method approach to explore a broad range of conditions that may lead to sustained peace or a resurgence of conflict after an intrastate conflict. By formally evaluating a theoretical framework grounded in the bargaining model of war and credible commitment mechanisms, it analyzes the role of fear-reducing, cost-increasing, and confidence-building mechanisms in the transition process.

Drawing on and synthesizing insights from the peacebuilding and post-conflict transition literature, this study identifies five explanatory conditions: power-sharing, transitional justice, transitional reform, international assistance, and the implementation process. While these conditions are well established in existing scholarship, the study advances the literature in several important ways. Conditions that have previously been examined individually or in partial combinations are synthesized within an integrated and systematic analytical framework. Building on and extending Mattes and Savun's (2009, 2010) commitment mechanisms approach, we introduce a new typology that classifies these conditions as fear-reducing, cost-increasing, and confidence-building mechanisms. In particular, the confidence-building mechanism, represented by transitional justice and the implementation process, is proposed as an additional component to commitment mechanisms, arguing that it is critical for long-term stability. Transitional reform programs are reinterpreted as fear-reducing mechanisms, while the implementation process is reclassified as a confidence-building mechanism, offering new insights at the theoretical level. Thus, although the individual conditions themselves are widely accepted in the literature, their systematic combination, theoretical reclassification within the framework of commitment mechanisms, and the explicit incorporation of confidence-building mechanisms constitute the central innovations of this study.

To operationalize these conditions, the study classifies agreement provisions based on existing literature and develops 34 indicators and 171 sub-indicators. It then conducts a configurational comparison of 34 intrastate conflicts that resulted in comprehensive peace agreements between 1989 and 2012. Half of these cases are successful, and the other half are unsuccessful. Data for each case is sourced from the Armed Conflict Dataset (UCDP/PRIO 2024), the Peace Accords Matrix Implementation Dataset (PAM_ID) (Joshi and Darby 2013; Joshi, Quinn and Regan 2015), and the peace agreement texts from the United Nations (UN) Peacemaker Peace Agreements Database (United Nations Peacemaker 2024). These data are compiled into the Comprehensive Peace Agreements Implementation Dataset (CPA_ID), developed as part of this study.

Methodologically, the study embraces a conjunctural, equifinal, and asymmetric understanding of causality and employs fuzzy-set Qualitative Comparative Analysis (fs/QCA), bridging quantitative and qualitative research traditions. This approach enables the systematic assessment of theoretically grounded hunches by identifying intersections between the theoretical framework and the Boolean expressions in the solution formulas. Theoretically, the study contributes to a deeper understanding of the commitment problem in post-civil war peace processes, framing conflict recurrence as a breakdown in the bargaining process. It argues that the combined and context-specific application of fear-reducing, cost-increasing, and confidence-building mechanisms significantly enhances the prospects for sustainable peace.

The empirical findings indicate multiple sufficient pathways to successful transitions. The results align broadly with initial theoretical expectations and underscore the importance of credible commitment mechanisms. The findings suggest the need to reassess the existing theoretical framework—particularly by interpreting transitional reform programs as fear-reducing mechanisms and the implementation process as a confidence-building mechanism—offering novel insights in this regard. The study also categorizes cases as typical, deviant, and individually irrelevant, and conducts a comparative analysis of the Dayton Agreement (1995), Bougainville Agreement (2001), Chapultepec Agreement (1992), Accra Accord (2003), Helsinki Memorandum of Understanding (2005), Paris Peace Agreements (1991), Abidjan Agreement (1996), and Lusaka Protocol (1994) to test the properties that link specific sufficient configurations to the outcome.

The study is structured as follows. The first section reviews the relevant literature and presents the theoretical framework. The second section outlines the methodological approach. The third section details the research design, including the outcome of interest, explanatory conditions, and case selection criteria. The fourth section presents the analytical results, including fuzzy-set calibration, truth table construction, Boolean minimization, necessity and sufficiency analyses, and robustness tests. The fifth section establishes a dialogue between the theoretical framework and the empirical findings, discussing the main results and comparing typical and individually irrelevant cases. The final section assesses the overall contribution of the study and offers recommendations for future research.

Design and Implementation of Peace Agreements

In existing literature, studies focusing on the design and implementation of peace agreements have been prevalent in the post-Cold War period. Hampson's (1996) work was influential in understanding why some peace agreements fail and others succeed. Further studies have examined the relationship between various types of agreement provisions, such as third-party guarantees, power-sharing, security sector reforms, and the context and level of implementation of the agreements, and their impact on peace duration (Hartzell 1999; Walter 1999, 2002; Hartzell, Hoddie and Rothchild 2001; Hartzell and Hoddie 2003, 2007; Fortna 2003, 2004;

Quinn, Mason and Gurses 2007; DeRouen, Lea and Wallensteen 2009; Jarstad and Nilsson 2008; Badran 2014; Joshi and Quinn 2017; Mac Ginty, Joshi and Lee 2019). Additionally, researchers have qualitatively analysed specific cases to provide insights. Among these cases, Nicaragua, El Salvador, Guatemala, Rwanda, Bosnia, Lebanon, Liberia, Mozambique, Angola, Northern Ireland, United Kingdom-Northern Ireland, Indonesia-Aceh, Burundi, and Mali stand out (Stedman, Rothchild and Cousens 2002; Bekoe 2008; Kirschner and von Stein 2009; DeRouen et al. 2010). This literature review outlines various theoretical and empirical approaches to understanding post-conflict stabilization.

This article uses the bargaining model of war to understand which types of civil war peace agreement provisions lead to lasting peace and overcome commitment problems. This theory emphasizes that war is not an irrational act but the result of failures in bargaining processes. It is based on the idea that war is costly and that rational actors should prefer to reach an agreement without fighting to avoid these costs (Fearon 1995, 1998; Powell 2002, 2006). Based on this theory, we identified commitment and information problems as significant causes for the failure of bargaining. The parties' inability to credibly commit to abide by the terms of the peace agreement stems from the fact that they are in an anarchic environment where they cannot rely on any neutral authority to conduct such a bargain. Scholars have pointed out that changes in power distribution, expected benefits outweighing costs, and miscalculations due to lack of information can lead to bargaining breakdown and recurrence of conflict (Wagner 2000; Walter 2002; Reiter 2003).

This study argues that carefully designed and highly implemented peace agreements can solve commitment and information problems, facilitate transitions from conflict to peace, and reduce the likelihood of civil war recurrence. The literature has emphasized two mechanisms: those that reduce fear and those that increase cost. Both mechanisms reduce future uncertainty about conflicting parties' survival by limiting their ability to withdraw from an agreement and making the resumption of violence costly than the status quo (Mattes and Savun 2009, 2010). In this regard, both third-party guarantees and power-sharing institutions have been shown to play a crucial role in preventing conflict recurrence (Walter 1997, 2002; Doyle and Sambanis 2000, 2006; Hartzell, Hoddie and Rothchild 2001; Fortna 2004; Hartzell and Hoddie 2007; Quinn, Mason and Gurses 2007; Jarstad and Nilsson 2008; Joshi 2013).

This study proposes the confidence-building mechanism as an additional component. This mechanism fosters conflict parties to develop trust in each other, strengthen their conviction that they will fulfil their commitments, and ensure long-term stability. In this context, transitional justice and the implementation process can be considered mechanisms that support confidence-building by reducing suspicion between the parties. In addition to power-sharing, the study addresses transitional reform programs as a fear-reducing mechanism. This framework makes a theoretical contribution by systematically examining other issues widely debated in the literature on post-conflict transition within the framework of bargaining model of war.

While there are variable-oriented and case-based studies in the existing literature that focus on individual aspects of the post-conflict process, there is a lack of configurational analyses that integrate certain features of qualitative and quantitative research traditions. Few studies focus on identifying the "necessary" and "sufficient" conditions/ combinations of conditions to explain post-conflict peacebuilding (Leib 2016; Fontana et al. 2020; Mross, Fiedler and Grävingholt, 2022). This study aims to fill this gap by conducting a configurational comparative analysis based on set theory, Boolean logic, and John Stuart Mill's agreement and difference methods.

Methodology

In this article, we start from the principle of causal complexity and accept three assumptions: 1) the outcome is jointly affected by more than one condition (conjunctural causation); 2) different conditions (or combinations thereof) can lead to the same outcome (equifinality); and 3) a specific relationship between a condition and an outcome does not necessarily imply that the reverse is also true (asymmetric causation). We use set theory to find necessary and sufficient conditions for the outcome, Boolean algebra to obtain the solution terms by constructing and minimizing a truth table, and John Stuart Mill's inductive methods (methods of agreement and difference) to compare cases for similarities and differences. Charles Ragin (2014) integrated these and introduced a research method known as Qualitative Comparative Analysis (QCA). This method looks at set relationships rather than correlations and focuses on outcomes and explanatory conditions. It examines cases holistically, focusing on specific configurations of attributes, and is typically suitable for a medium number of cases. Different variants of this method have developed over time (Rihoux and Ragin 2009; Schneider and Wagemann 2012; Mello 2021).

In this study, we employed the fs/QCA method because it allows for differences in both the type and the degree of conditions. Unlike the conventional binary distinctions (0 or 1) in crisp-set analysis, fuzzy-set membership scores range from 0.0 (full non-membership) to 1.0 (full membership). This approach enables a more nuanced assessment of differences in degree across cases and facilitates fine-grained analysis, including the systematic incorporation of cases with partial membership (Ragin 2000, 2008; Schneider and Wagemann 2012: 25; Rohlfing 2019). This choice is particularly appropriate given the gradual and non-binary nature of post-conflict processes.

Using this method, our goal is to identify the necessary and sufficient combinations of conditions. Necessity analysis determines the conditions or their combinations that are consistently present when the outcome occurs (i.e., the outcome is a subset of the condition). Conversely, sufficiency analysis pinpoints the combinations of conditions that consistently coincide with the presence of the outcome (i.e., the outcome is a superset of the condition). These are referred to as INUS conditions and SUIN conditions (Ragin 2000: 203-260; Schneider and Wagemann 2012: 56-90). The analytical procedure uses a truth table and the

Quine-McCluskey algorithm to summarize and identify patterns in the data (Ragin 2008: 124-141; Schneider and Wagemann 2012: 91-116).

The choice of this method is based on its congruence with our methodological framework, underlying assumptions, and research objectives. It accommodates causal complexity and allows for the identification of both necessary and sufficient combinations of conditions for an outcome. In this respect, it has advantages over large-N analysis. It represents a middle ground between qualitative and quantitative methods, is sensitive to individual cases, and allows for modest generalization (Ragin 2008, 2014). It can be effectively combined with other methods, such as process tracing (Schneider and Rohlfing 2013; Beach 2018). Its analytical protocol offers systematic tools for comparing cases and allows for counterfactual reasoning by addressing logical remainders. The aim is ultimately to identify both typical or deviant cases as well as ideal types or causal paths (Schneider and Wagemann 2012; Schneider and Rohlfing 2016).

Research Design

This section describes the article's set-theoretic research design. We conceptualize the outcome of interest and explanatory conditions as target sets, assign a fuzzy-set membership score to each case through a calibration process, and specify the criteria for case selection. We developed the CPA_ID dataset by utilizing various data sources.[1]

Case Selection

The unit of analysis in this article is comprehensive intrastate peace agreements. We selected cases that reflect the diversity of configurations, i.e., maximum heterogeneity in condition and outcome values. A medium number of cases were selected based on the method. The criteria for case selection are (i) signed after the Cold War period, (ii) aiming to end intrastate conflict, (iii) addressing the substantive issues underlying the conflict, (iv) signed between the main parties to the conflict, with at least one being the government that controls the capital of the state, (v) signed as a result of negotiation, (vi) mutual acceptance, (vii) being in writing and publicly available.

To construct the case population, we utilized the PAM_ID created by researchers at the Kroc Institute for International Peace Studies at the University of Notre Dame (Joshi, Quinn and Regan 2015). Thirty-four peace agreements from this dataset were included in the population because they fulfilled the criteria. Of the 34 cases, 18 are located in Africa, eight are in Asia and the Pacific, four are in Europe, two are in Central America, and two are in the Middle East and West Asia. Regarding conflict type, 22 are governmental, and 12 are territorial. The distribution of cases aligns proportionally with the number of conditions specified (34/5). The list of cases is included in Appendix 1.

1 This dataset and codebook are presented in the Supplementary Material available at the Harvard Dataverse: https://doi.org/10.7910/DVN/FWBFPE.

Defining the Outcome and Explanatory Conditions

The outcome of interest is a successful transition from conflict to negative peace (SCNPT). We define this outcome using Galtung's (1964) concept of negative peace, which refers to the absence of direct violence. This concept is chosen not only for its availability of measurable data but also because it serves as a crucial prerequisite for peace. Specifically, the outcome is defined as a transition from an environment characterized by political violence—whether related to governmental or territorial disputes—to an environment devoid of direct violence. This transition occurs between the government and at least one rebel or opposition group within the borders of a sovereign state that controls a specific territory and is recognized by other states. Additionally, this transition involves cases where at least 25 individuals have died as a result of armed conflict within a calendar year. The definitions of armed conflict provided by the UCDP/PRIO are used here (Gleditsch et al. 2002; Pettersson 2024). For each case, we count the number of years of conflict within 15 years following the signing of a peace agreement, offering a long-term perspective in comparison to other studies.

Building on extensive prior research on the design and implementation of peace agreements (Joshi and Darby 2013; Joshi, Quinn, and Regan 2015; Bell and Badanjak 2019; Pettersson, Högbladh, and Öberg 2019; Fontana et al. 2020), this study identifies five key conditions to explain successful transitions from conflict to peace: (a) power-sharing, (b) transitional justice, (c) transitional reform, (d) international assistance, and (e) the implementation process. Although these conditions have been examined individually or in various combinations, they have not been systematically synthesized into a unified analytical framework. The selection of these conditions is firmly grounded in recurring themes identified in the peacebuilding and post-conflict transition literature. These themes are operationalized as condition indicators in this study.

Extending the framework developed by Mattes and Savun (2009, 2010), this study proposes a novel typology that classifies these five conditions into three distinct categories of commitment mechanisms:

- Power-sharing and transitional reform as fear-reducing mechanisms that alleviate the existential security concerns of conflicting parties;
- International assistance as a cost-increasing mechanism that raises the cost of non-compliance;
- Transitional justice and the implementation process as confidence-building mechanisms that foster trust and mutual belief in long-term cooperation.

This proposed typology serves as the theoretical foundation for the configurational comparative analysis conducted in this study, enabling the identification of necessary and/or sufficient combinations of conditions for successful transitions from conflict to peace. Systematized within the bargaining model of war (Fearon 1995; Powell 2006), this approach demonstrates how different agreement provisions can theoretically play complementary

roles in overcoming bargaining failures. Analyzing these five conditions within a structured comparative framework not only synthesizes existing insights but also contributes to the theoretical literature by offering a more comprehensive and systematic lens for evaluating peace processes.

To operationalize the conditions, different types of provisions in peace agreements were first grouped under specific categories, and sub-indicators were defined for each of these categories. A comprehensive list of indicators was developed, resulting in 171 sub-indicators: 17 for power-sharing, 66 for transitional justice, 73 for transitional reform, and 15 for international assistance. Power-sharing provisions were subsequently aggregated into an index ranging from 0 to 3, transitional justice provisions from 0 to 12, transitional reform provisions from 0 to 16, and international assistance provisions from 0 to 3. For each case, the data framework was constructed by coding the presence (1) or absence (0) of indicators. Table 1 provides definitions and indicators for each condition.

Table 1. Explanatory Conditions

Explanatory conditions	Definition	Indicators
Power-sharing	A system in which conflicting parties share decision-making responsibilities in governing institutions.	Political power-sharing, economic power-sharing, and military power-sharing.
Transitional justice	Judicial and non-judicial mechanisms for society's attempts to come to terms with the legacy of conflict during the transition from conflict to peace.	Amnesty; prisoner release; human rights; indigenous and minority rights; women's rights and gender issues; civil and political rights; economic, social, and cultural rights; victims and reparations; refugees and internally displaced persons; truth commission; reconciliation; and protection measures.
Transitional reform	The reform of corrupt and oppressive political and military institutions, branches, or mechanisms in the transition from conflict to peace.	Constitutional reform; legislative branch reform; executive branch reform; judicial branch reform; public administration reform; military reform; police reform; education reform; media reform; demobilization, disarmament and reintegration; transitional timeline; electoral and political party reform; socio-economic development; cultural heritage/protections; financial arrangements; and dispute settlement mechanisms.
International assistance	The provision of aid and support from other states, governments, or international organizations.	Verification and monitoring mechanisms; peacekeeping; and international assistance and advice.
Implementation process	The execution of provisions of the agreement during the transition from conflict to peace.	PAM_ID variables

Raw data on the first four conditions for 34 cases were obtained from agreement texts downloaded from the UN Peace Agreements Database (United Nations Peacemaker 2024). Data on the implementation process condition was sourced from the PAM_ID (Joshi and Darby 2013; Joshi, Quinn and Regan 2015). This dataset measures the implementation of 51 defined provisions in comprehensive intrastate peace agreements over ten years following the signing of the agreement. This dataset aligns with the indicators for the other four conditions. A total of 85 indicators were recorded in a numerically coded dataset, the Comprehensive Peace Agreements Implementation Dataset (CPA_ID), created by compiling qualitative and quantitative data. This dataset provides detailed information on 34 comprehensive peace agreement cases.[2]

Calibration of Data

The calibration process involves transforming raw data into fuzzy set membership scores. This process is based on the total score of each case on the relevant condition indicator. Once the outcome and explanatory conditions were defined as target sets, they were calibrated using "the direct method." This method transforms raw data into fuzzy-set values based on three qualitative cut-off points. Specifically, three qualitative anchors—full membership, point of indifference, and full non-membership—are employed to convert raw data into fuzzy scores ranging from 0 to 1 through a logistic function (Ragin 2000, 2008: 89-94; Schneider and Wagemann 2012: 35-40). Once the thresholds are determined, the data are scaled into set memberships, with values close to 1 indicating "more inside than outside" the set, while values close to 0 signify "more outside than inside" the set. A value of 0.50 is considered the point of maximum ambiguity, where it cannot be determined whether a case is in or out of the target set (Ragin 2008: 30-31).

During the calibration process, the qualitative difference for the multidimensional power-sharing (PS) and strong international assistance (IA) target sets is determined by including more than one indicator in the agreement. For the target sets of robust transitional justice (TJ), comprehensive transitional reform (TR), and a high-level implementation process (IP), the qualitative distinction is defined by incorporating more than four-fifths of the indicators into the agreement, ensuring that these target sets maintain a high standard. Table 2 presents label identifiers for each comprehensive peace agreement case, qualitative cut-off points for each target set (full non-membership, point of indifference, full membership), and the calibrated data.[3]

2 CPA_ID and Codebook are presented in the Supplementary Material (available at the Harvard Dataverse: https://doi.org/10.7910/DVN/FWBFPE).

3 Details of the calibration process are presented in the Supplementary Material.

Table 2. Calibrated Data

Cases	Multidimensional Power-sharing (PS)	Robust Transitional Justice (TJ)	Comprehensive Transitional Reform (TR)	Strong International Assistance (IA)	High-level Implementation Process (IP)	Successful Transition from Conflict to Negative Peace (SCNPT)
Lebanon – 1989 (Leb89)	0,27	0,09	0,78	0,27	0,32	0,47
Cambodia – 1991 (Cam91)	0,73	0,31	0,41	0,95	0,44	0,21
El Salvador – 1992 (Sal92)	0,73	0,65	0,61	0,95	0,91	0,96
Mali – 1992 (Mal92)	0,73	0,31	0,78	0,27	0,62	0,42
Mozambique – 1992 (Moz92)	0,73	0,31	0,41	0,95	0,86	0,96
India – 1993 (Ind93)	0,95	0,20	0,61	0,05	0,11	0,15
Rwanda – 1993 (Rwa93)	0,73	0,39	0,47	0,95	0,45	0,18
South Africa – 1993 (SoA93)	0,73	0,65	0,78	0,05	0,86	0,96
Angola – 1994 (Ang94)	0,73	0,31	0,36	0,95	0,28	0,25
Djibouti – 1994 (Dji94)	0,95	0,20	0,26	0,27	0,80	0,47
Niger – 1995 (Nig95)	0,95	0,20	0,36	0,27	0,37	0,96
Croatia – 1995 (Cro95)	0,27	0,15	0,18	0,95	0,44	0,96
Bosnia and Herzegovina – 1995 (Bos95)	0,95	0,65	0,78	0,95	0,88	0,96
Philippines – 1996 (Phi96)	0,95	0,20	0,78	0,73	0,33	0,05
Sierra Leone – 1996 (Sie96)	0,73	0,31	0,47	0,73	0,06	0,29
Guatemala – 1996 (Gua96)	0,27	0,86	0,90	0,95	0,40	0,96
Tajikistan – 1997 (Taj97)	0,73	0,25	0,30	0,95	0,47	0,33
Bangladesh – 1997 (Ban97)	0,73	0,46	0,36	0,05	0,24	0,96
United Kingdom – 1998 (UKg98)	0,27	0,46	0,90	0,27	0,90	0,96
Guinea-Bissau – 1998 (GuB98)	0,27	0,07	0,12	0,95	0,91	0,47

Timor-Leste – 1999 (Ins99)	0,73	0,20	0,78	0,95	0,89	0,96
Sierra Leone – 1999 (Sie99)	0,95	0,65	0,47	0,95	0,62	0,42
Congo – 1999 (Con99)	0,27	0,20	0,21	0,73	0,44	0,47
Burundi – 2000 (Bur00)	0,73	0,95	0,95	0,95	0,49	0,15
Djibouti – 2001 (Dji01)	0,27	0,39	0,41	0,27	0,27	0,96
Macedonia – 2001 (Mac01)	0,73	0,25	0,90	0,95	0,84	0,96
Papua New Guinea – 2001 (PNG01)	0,95	0,20	0,61	0,95	0,80	0,96
Angola – 2002 (Ang02)	0,27	0,12	0,15	0,95	0,77	0,96
Liberia – 2003 (Lib03)	0,95	0,65	0,78	0,95	0,77	0,96
Senegal – 2004 (Sen04)	0,05	0,20	0,10	0,05	0,15	0,47
Sudan – 2005 (Sud05)	0,95	0,86	0,95	0,95	0,46	0,06
Indonesia – 2005 (Ins05)	0,95	0,46	0,78	0,73	0,75	0,96
Nepal – 2006 (Nep06)	0,05	0,86	0,95	0,95	0,43	0,96
Côte d'Ivoire – 2007 (Ivo07)	0,27	0,25	0,41	0,73	0,62	0,47
Qualitative anchors	2.95, 1.50, 0.05	11.95, 9.50, 0.05	15.95, 12.50, 0.05	2.95, 1.50, 0.05	99.95, 79.50, 0.05	0.05, 0.50, 4.95

Analysis and Results

In this section, we describe the steps involved in the analysis. We began by creating a truth table using calibrated data and presenting parameters of fit. Then, we conducted Standard Analysis through Boolean minimization and obtaining solution formulas. We performed these steps using the RStudio graphical user interface with functions from the "SetMethods" (Oana and Schneider 2018) and "QCA" (Dusa 2019) packages. All results, including post-analysis operations such as robustness tests and cluster diagnostics, are reported in the Supplementary Material.

In the first step of the analysis, we examined the necessary conditions and found that no single condition could be considered necessary for the SCNPT (see Appendix 2). Each condition had consistency[4] values below 0.9, which is the necessity threshold. This suggests that no single condition is present when the outcome occurs, indicating that these conditions are far from being a perfect superset of the outcome. Therefore, evaluating the coverage and relevance of necessity (RoN) parameters[5] for single conditions is not meaningful. By adjusting the consistency threshold to 0.9, the coverage threshold to 0.6, and the RoN to 0.5, we identified four combinations of necessary disjunctions. Although these conditions showed high consistency and coverage, their RoN values were low, likely due to skewness.

In the second step, we identified sufficient conditions and their combinations for SCNPT. A subset relationship is defined when the membership score in a condition is less than or equal to the outcome (Schneider and Wagemann 2012: 65-69). During sufficiency analysis, parameters of fit are tested to address deviations from perfect set relationships. A consistency threshold of 0.8 is used for inclusion, which formally indicates the fit of a configuration to SCNPT. We also assessed deviant cases consistency in both kind and degree. The proportional reduction in inconsistency (PRI) value is set to 0.7 to identify simultaneous subset relationships and avoid contradictory sufficiency statements (Schneider and Wagemann 2012: 237-244). Finally, the coverage parameter is evaluated. The calibrated data are transformed into a truth table, as shown in Table 3. Configurations meeting the consistency and PRI thresholds are considered sufficient.

4 The consistency parameter evaluates to what extent the outcome can be considered a subset of the condition, and takes into account how many cases deviate from the necessity model and the strength of that deviation. See Ragin 2008: 45-54; Schneider and Wagemann 2012: 139-150.

5 The coverage and relevance of necessity parameters are measures of how trivial or relevant a necessary condition is for an outcome. See Ragin 2008: 54-68; Schneider and Wagemann 2012: 233-237.

Table 3. Truth Table for the SCNPT[6]

row	PS	TJ	TR	IA	IP	OUT	n	incl	PRI	cases
6	0	0	1	0	1	1	1	1	1	UKg98
30	1	1	1	0	1	1	1	0.965	0.923	SoA93
3	0	0	0	1	0	1	2	0.952	0.853	Cro95, Con99
15	0	1	1	1	0	1	2	0.948	0.877	Gua96, Nep06
5	0	0	1	0	0	1	1	0.946	0.811	Leb89
1	0	0	0	0	0	1	2	0.922	0.764	Dji01, Sen04
4	0	0	0	1	1	1	3	0.918	0.808	GuB98, Ang02, Ivo07
17	1	0	0	0	0	1	2	0.915	0.811	Nig95, Ban97
22	1	0	1	0	1	1	1	0.912	0.797	Mal92
24	1	0	1	1	1	1	4	0.907	0.849	Ins99, Mac01, PNG01, Ins05
18	1	0	0	0	1	1	1	0.903	0.752	Dji94
28	1	1	0	1	1	1	1	0.903	0.795	Sie99
20	1	0	0	1	1	1	1	0.89	0.787	Moz92
32	1	1	1	1	1	1	3	0.855	0.763	Sal92, Bos95, Lib03
21	1	0	1	0	0	0	1	0.861	0.668	Ind93
31	1	1	1	1	0	0	2	0.797	0.577	Bur00, Sud05
23	1	0	1	1	0	0	1	0.791	0.561	Phi96
19	1	0	1	1	0	0	5	0.768	0.532	Cam91, Rwa93, Ang94, Sie96, Taj97
2	0	0	0	0	1	?	0	-	-	
7	0	0	1	1	0	?	0	-	-	
8	0	0	1	1	1	?	0	-	-	
9	0	1	0	0	0	?	0	-	-	
10	0	1	0	0	1	?	0	-	-	
11	0	1	0	1	0	?	0	-	-	
12	0	1	0	1	1	?	0	-	-	
13	0	1	1	0	0	?	0	-	-	
14	0	1	1	0	1	?	0	-	-	
16	0	1	1	1	1	?	0	-	-	
25	1	1	0	0	0	?	0	-	-	
26	1	1	0	0	1	?	0	-	-	
27	1	1	0	1	0	?	0	-	-	

6 OUT = output value, n = number of cases in configuration, incl = sufficiency inclusion score, PRI = proportional reduction in inconsistency, logical remainders are marked "?".

As seen in Table 3, 14 out of 32 logically possible combinations of the five explanatory conditions are not represented by empirical evidence (cases). These so-called logical remainders (OUT = ?) are part of the minimization process and used for counterfactual analysis (Ragin 2008: 147-175; Schneider and Wagemann 2012: 151-177; Mello 2021: 143-147). Of the 32 rows, 14, which corresponds to approximately three-quarters of the cases, are deemed sufficient (OUT = 1) because they meet the specified thresholds for the parameters of fit. These sufficient rows are considered "primitive expressions" in the minimization process, whereas the remaining four (OUT = 0) are deemed insufficient for SCNPT.

The next step involves minimizing the truth table using Boolean algebra to obtain solution formulas. The Quine-McCluskey algorithm facilitates this minimization procedure (Ragin 2014: 85-102). Depending on the remainder rows processed, various solution formulas—conservative, parsimonious, and intermediate—are produced, each differing in complexity, number of conditions, and assumptions. During the Standard Analysis protocol, cases for which the outcome is available are minimized to produce prime implicants, leading to a "conservative solution formula" (Schneider and Wagemann 2012: 160-77). Six distinct models for this solution are detailed in the Supplementary Material. This variability is referred to as "model ambiguity" in the literature (Baumgartner and Thiem 2017). To address model ambiguity, two "directional expectations" are incorporated to produce an "intermediate solution" through counterfactual reasoning. It is anticipated that an agreement with a comprehensive transitional reform program and a high level of implementation will promote sustainable peace. Among the "simplifying assumptions"—the remainders contributing to logical minimization and helping generate prime implicants—the intermediate solution formula is produced by including "easy counterfactuals" (rows 2, 7, 8, and 16) in the minimization process.

Table 4. Intermediate Solution for the SCNPT[7]

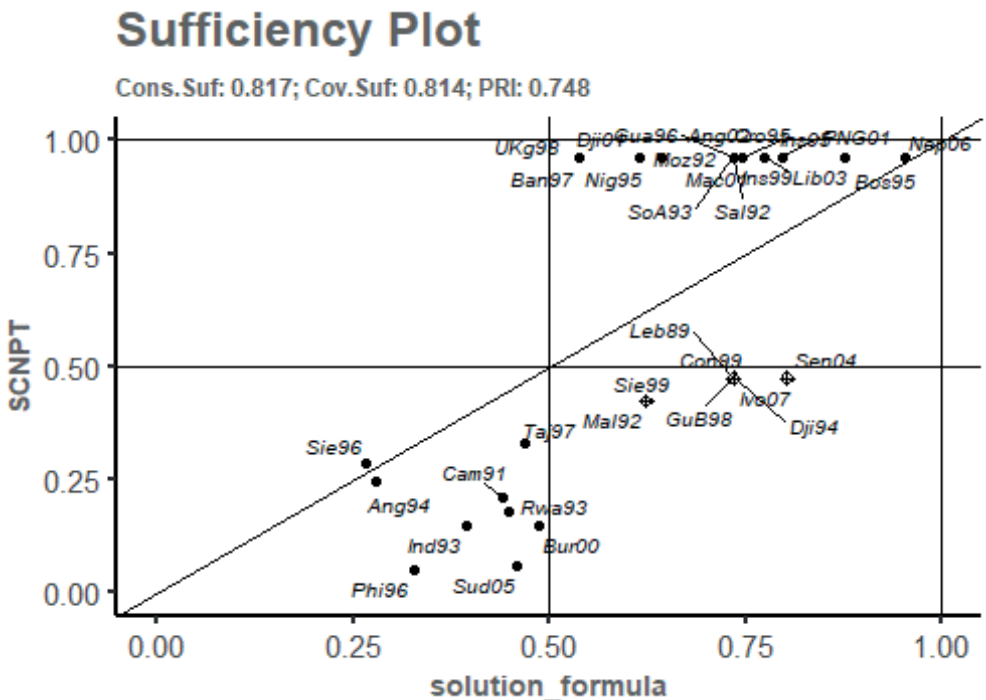
From C1P1, C2P1, C3P1, C4P1, C5P1, C6P1:
M1: ~PS*~TJ + ~PS*TR*IA + PS*TR*IP + PS*IA*IP + ~TJ*~TR*~IA → SCNPT

Paths	inclS	PRI	covS	covU	cases
~PS*TR*IA	0.960	0.922	0.312	0.059	Gua96, Nep06
PS*TR*IP	0.865	0.805	0.519	0.029	Mal92; Ins99, Mac01, PNG01, Ins05; SoA93; Sal92, Bos95, Lib03
PS*IA*IP	0.856	0.793	0.517	0.035	Moz92; Ins99, Mac01, PNG01, Ins05; Sie99; Sal92, Bos95, Lib03
~PS*~TJ	0.852	0.729	0.405	0.089	Dji01, Sen04; Cro95, Con99; GuB98, Ang02, Ivo07; Leb89; UKg98
~TJ*~TR*~IA	0.847	0.686	0.256	0.037	Dji01, Sen04; Nig95, Ban97; Dji94
M1	0.817	0.748	0.814		

7 M1 = minimization model (solution), inclS = sufficiency inclusion score, PRI = proportional reduction in inconsistency, covS = coverage for sufficiency, covU = unique coverage, logical disjunction (OR) is denoted by the sign "+", logical conjunction (AND) is denoted by the sign "*", negation (logical NOT) is denoted with a "~" sign.

The intermediate solution comprises five sufficient terms, each involving at least two conjunctions. As detailed in Table 4, the model fit for the solution is reasonable, scoring 0.817 for consistency and 0.814 for empirical coverage. The low unique coverage rate indicates a high number of overlapping cases. Note that all solution terms deviate to some extent from perfect subset relations, indicating that the solution terms do not cover all outcome fuzzy-set membership scores. Figure 1 illustrates this deviation through an XY plot of the intermediate solution formula.

Figure 1. XY Plot for the Solution Formula



This plot illustrates the placement of cases within four quadrants based on their membership in the solution formula (S) and the SCNPT (Y), with each quadrant representing a specific type of case (Schneider and Wagemann 2012: 306-08):

- Typical Cases (S > 0.5 and Y ≥ 0.5): These cases are members of both the solution formula and the SCNPT. Examples include Moz92, Sal92, SoA93, Nig95, Bos95, Cro95, Gua96, Ban97, UKg98, Ins99, Dji01, Mac01, PNG01, Ang02, Lib03, Ins05, and Nep06. These cases are relevant for identifying the causal relationship that links the solution terms to the SCNPT.
- Deviant Cases (S > 0.5 and Y < 0.5: These cases are members of the solution formula but not of the SCNPT. Examples include Leb89, Mal92, Dji94, GuB98, Sie99, Con99, Sen04, and Ivo07. They are important for identifying potential missing conjunctions in the solution formula.

- Unexplained Cases (S < 0.5 and Y > 0.5): No cases fall into this upper-left quadrant, indicating that there are no unexplained cases where the outcome occurs without the presence of the solution formula.
- Individually Irrelevant Cases (S < 0.5 and Y < 0.5): These cases are neither members of the solution formula nor the SCNPT. Examples include Cam91, Ind93, Rwa93, Ang94, Phi96, Sie96, Taj97, Bur00, and Sud05. Such cases are not relevant for individual within-case analyses aimed at identifying the causal relationship between the solution terms and the SCNPT.

As the final step, robustness and diagnostic tests are performed, applying the Robustness Test Protocol, which involves three steps (Oana, Schneider and Thomann 2021: 144-158). First, the sensitivity ranges for the calibration threshold, raw consistency threshold, and frequency cut-off of each causal condition are tested. These threshold choices were evaluated and deemed both appropriate and reasonable. Second, a fit-oriented robustness test is performed. When the solution is tested against a set of reasonable analytical changes, it is found to be robust concerning the parameters of fit. Finally, three case-oriented robustness parameters are used to express the robustness of the initial solution. For the robustness case ratio for typical cases (0.824) and deviant cases (0.889), the initial solution is relatively robust, deviating from perfect but close to 1. For the Rob_Case_Rank parameter, the third rank is obtained, indicating the presence of shaky cases but no possible typical or deviant cases.

Discussion

The findings reveal multiple pathways leading to SCNPT, indicating that it emerges from the combined effect of several conditions. Based on the intermediate solution formula, there is empirical overlap, particularly between the sufficient configurations PS*TR*IP and PS*IA*IP. Typical cases exemplifying these pathways include Sal92, Bos95, PNG01, Lib03, and Ins05.

In the case of the Dayton Agreement (Bos95), multidimensional power-sharing mechanisms were established to ensure the representation of the three main ethnic groups—Bosniaks, Serbs, and Croats—in government (0.95). Significant steps were taken to establish justice mechanisms (0.65), and structural reforms were planned in the constitutional, judicial, and security sectors (0.78). The process received strong support from the international community, especially the US, EU, and UN (0.95). The implementation was highly organized (0.88), ultimately resulting in stable negative peace.

For the Bougainville Agreement (PNG01), a multidimensional power-sharing system was envisaged (0.95), and reforms were designed in governance, security, and selected social sectors (0.61). However, justice mechanisms remained underdeveloped (0.20). The international community played a critical role in supporting the peace process (0.95), and significant provisions of the agreement were implemented (0.80), resulting in stable negative peace.

The Chapultepec Agreement (Sal92) established a power-sharing mechanism to integrate the FMLN into the political system (0.73) and included effective justice mechanisms (0.65). Comprehensive reforms were envisioned, addressing military-civilian relations, the security sector, the judiciary, and human rights (0.61). Strong international assistance was provided through the ONUSAL mission (0.95). The process was managed meticulously under UN supervision, achieving a high implementation score (0.91) and ending the civil war in El Salvador.

The Accra Accord (Lib03) also featured a multidimensional power-sharing mechanism (0.95) and a comprehensive reform agenda (0.78). International support was delivered through monitoring committees and UNMIL peacekeepers (0.95), and the agreement saw a relatively high implementation level (0.77). Together with robust transitional justice mechanisms (0,65), these efforts contributed to the establishment of a stable negative peace.

The Helsinki Memorandum of Understanding (Ins05) included multidimensional power-sharing mechanisms, such as special autonomy for Aceh (0.95), and a broad reform program (0.78). While transitional justice mechanisms were limited (0.46), the process received strong international assistance (0.73). The relatively high implementation score (0.75) reflected substantial commitment from both parties. As a result, the conflict in Aceh was effectively resolved, with the disarmament of the Free Aceh Movement (GAM) and post-tsunami reconciliation efforts helping to prevent a resurgence of conflict.

These cases demonstrate that power-sharing, when combined with international assistance, comprehensive transitional reforms, and high implementation success, fosters stable negative peace. In line with previous research (Hartzell and Hoddie 2003, 2007; Walter 1999, 2002; Mattes and Savun 2009, 2010), the findings suggest that power-sharing and international assistance function as fear-reducing and cost-increasing mechanisms to address commitment problems. Yet, these conditions alone are insufficient for achieving SCNPT. When combined with transitional reforms as a fear-reducing mechanism or with the implementation process as a confidence-building mechanism, they provide a sufficient explanation for SCNPT. In the absence of these complementary conditions, conflicts often resurged, as seen in Cam91, Ang94, and Sie96.

Figure 2. Comparison of typical and individually irrelevant (IIR) cases

Case	PS	TJ	TR	IA	IP	SCNPT
Sal92	✓	✓	✓	✓	✓	✓
Bos95	✓	✓	✓	✓	✓	✓
PNG01	✓	✗	✓	✓	✓	✓
Lib03	✓	✓	✓	✓	✓	✓
Ins05	✓	✗	✓	✓	✓	✓
Cam91	✓	✗	✗	✓	✗	✗
Ang94	✓	✗	✗	✓	✗	✗
Sie96	✓	✗	✗	✓	✗	✗

The Paris Peace Agreements (Cam91) incorporated a multidimensional power-sharing arrangement among the Khmer Rouge, the Vietnamese-backed People's Republic of Kampuchea, pro-Sihanouk factions, and other opposition groups (0.73). Although transitional justice (0.31) and reform provisions (0.41) were limited, the agreement benefited from strong international assistance, particularly through UNTAC and substantial foreign aid (0.95). Despite this, overall progress remained limited (0.44) due to domestic resistance and complex political dynamics. As a result, low-intensity conflict persisted through the 1990s.

The Abidjan Agreement (Sie96) included multidimensional power-sharing (0.73), securing representation for the Revolutionary United Front (RUF), and was backed by international assistance (0.73). However, it lacked robust provisions for transitional justice (0.31) and reform programs (0.47). The RUF's non-compliance, weak governmental commitment, and persistent mutual distrust severely undermined implementation, resulting in an extremely low implementation score (0.06) and leading to renewed conflict.

Similarly, the Lusaka Protocol (Ang94), despite including a multidimensional power-sharing arrangement (0.73) and strong international assistance (0.95), faced significant setbacks. Weak reform programs (0.36), delays in implementation (0.28), ineffective justice mechanism (0,31), and continued mistrust between the parties contributed to conflict recurrence.

Analysis of these four cases illustrates that peace agreement success hinges on the interplay of multiple conditions. Although all cases featured power-sharing and international assistance, these conditions alone did not ensure sustainable peace due to weak reforms, limited justice mechanisms, and ineffective implementation. Justice mechanisms, while important, were also insufficient without the support of comprehensive reforms. Overall, these cases underscore that sustainable peace requires a balanced combination of fear-reducing, cost-increasing, and confidence-building mechanisms. A deficit in any one of these mechanisms significantly heightens the risk of conflict recurrence.

For the typical and deviant cases discussed, counterfactual reasoning—assessing how changes in a specific condition would affect the outcome—can be conducted through within-case analysis. However, to effectively refine and test the theoretical framework, comparative within-case analysis is preferable. By comparing relevant typical cases for each focal conjunction, one can evaluate whether the causal mechanism is generalizable in terms of sufficiency. Additionally, comparing typical and IIR cases (e.g., Lib03 vs. Ang94) helps trace the causal pathway linking the sufficient condition to SCNPT. Similarly, comparative analysis of typical and deviant cases (e.g., Bos95 vs. Sie99) may reveal an INUS condition that was omitted from the relevant sufficient configuration.

Conclusion

This article contributes to the literature from theoretical, empirical, and methodological perspectives by comprehensively addressing the conditions that lead to the success of post-conflict peace processes. Going beyond existing variable-driven and case-based studies, it

uses fs/QCA to identify necessary and sufficient conditions and systematically examines the interaction between the commitment mechanisms that enable the transition to peace. It lays out various pathways supported by empirical evidence and proposes the confidence-building mechanism as an additional component.

Theoretically, it offers a new perspective on the effectiveness of peace agreements by reassessing the bargaining model of war and credible commitment theory. Empirically, it analyses the process of transition from conflict to peace based on the CPA_ID dataset developed in the study and suggests sufficient pathways supported by evidence. Its methodological contribution is that it provides an innovative framework of analysis using set theory and Boolean logic to identify necessary and sufficient conditions for a successful peace process. In this way, it goes beyond case studies and statistical methods in peace and conflict studies and uses a systematic approach to explain how different conditions interact.

The findings presented in this article summarize the patterns observed in the data on civil war peace agreements. It contributes to data exploration through a truth table and a systematic comparison of logically possible configurations. It is essential to clarify that the terms in the solution formula do not indicate causation; instead, they describe different paths to the SCNPT. Each case needs to be analyzed in its specific context to identify causal relationships. Future research could benefit from in-depth case studies of both typical and deviant cases, along with small-N comparative analyses involving typical and IIR cases. This article lays the groundwork for further research in this field by identifying different case types. The results not only highlight existing patterns but also provide important implications for the directions in which future research should focus.

Future studies could also gain from employing statistical methods, diversifying the case population, and differentiating the unit of analysis. This would require the development of specific databases. While recent studies have addressed the need for data on agreement design and provisions, reliable data on the implementation process remains a critical gap. To address this gap, research teams should receive institutional and financial support.

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Appendix 1: Case Population

Case_id	Country	Peace Agreement Name	Signature Date
Leb89	Lebanon	Taif Accords	22-Oct-1989
Cam91	Cambodia	Framework for a Comprehensive Political Settlement of the Cambodia Conflict	23-Oct-1991
Sal92	El Salvador	Chapultepec Peace Agreement	16-Jan-1992
Mal92	Mali	Pacte national conclu entre le gouvernement de la République du Mali et les mouvements et Fronts Unifiés de l'Azawad consacrant le statut particulier du nord au Mali	11-Apr-1992
Moz92	Mozambique	General Peace Agreement for Mozambique	04-Oct-1992
Ind93	India	Memorandum of Settlement (Bodo Accord)	20-Feb-1993
Rwa93	Rwanda	Peace Agreement between the Government of the Republic of Rwanda and the Rwandese Patriotic Front (Arusha Agreement)	04-Aug-1993
SoA93	South Africa	South African Constitution of 1993 (Interim Constitution)	18-Nov-1993
Ang94	Angola	Lusaka Protocol	15-Nov-1994
Dji94	Djibouti	Accord de paix et de reconciliation nationale	26-Dec-1994
Nig95	Niger	Accord établissant une paix définitive entre le Gouvernement de la République du Niger et l'Organisation de la Résistance Armée (ORA)	15-Apr-1995
Cro95	Croatia	Basic Agreement on the Region of Eastern Slavonia, Baranja and Western Sirmium (Erdut Agreement)	12-Nov-1995
Bos95	Bosnia and Herzegovina	General Framework Agreement for Peace in Bosnia and Herzegovina (Dayton Agreement)	21-Nov-1995
Phi96	Philippines	Final Agreement on the Implementation of the 1976 Tripoli Agreement between the Government of the Republic of the Philippines (GRP) and the Moro National Liberation Front (MNLF)	02-Sep-1996
Sie96	Sierra Leone	Peace Agreement between the Government of the Republic of Sierra Leone and the Revolutionary United Front of Sierra Leone (Abidjan Peace Agreement)	30-Nov-1996
Gua96	Guatemala	Agreement on a Firm and Lasting Peace	29-Dec-1996
Taj97	Tajikistan	General Agreement on the Establishment of Peace and National Accord in Tajikistan	27-Jun-1997
Ban97	Bangladesh	Chittagong Hill Tracts Peace Accord	02-Dec-1997
UKg98	United Kingdom, Northern Ireland	Northern Ireland Peace Agreement (The Good Friday Agreement)	10-Apr-1998
GuB98	Guinea Bissau	Agreement between the Government of Guinea Bissau and the Self-proclaimed Military Junta (Abuja Peace Agreement)	01-Nov-1998
Ins99	Indonesia, Portugal, Timor Leste	Agreement between the Republic of Indonesia and the Portuguese Republic on the Question of East Timor	05-May-1999
Sie99	Sierra Leone	Peace Agreement between the Government of Sierra Leone and the RUF (Lomé Peace Agreement)	07-Jul-1999
Con99	Congo	Accord de cessez-le-feu et de cessation des hostilités entre le Haut Commandement de la Force Publique et le Haut Commandement des Forces d'Autodéfense de la Résistance (FADR) en République du Congo	29-Dec-1999
Bur00	Burundi	Arusha Peace and Reconciliation Agreement for Burundi	28-Aug-2000
Dji01	Djibouti	Accord de réforme et de concorde civile	12-May-2001
Mac01	Former Yugoslav Republic of Macedonia	Framework Agreement (Ohrid Agreement)	13-Aug-2001
PNG01	Papua New Guinea	Bougainville Peace Agreement	30-Aug-2001
Ang02	Angola	Memorandum of Understanding between the Government of the Republic of Angola and UNITA on the Peace Process (Luena Agreement)	04-Apr-2002
Lib03	Liberia	Peace Agreement between the Government of Liberia, the Liberians United for Reconciliation and Democracy (LURD), the Movement of Democracy in Liberia (MODEL) and the Political Parties	18-Aug-2003
Sen04	Senegal	Ziguinchor Peace Agreement between Government of Senegal and MFDC	30-Dec-2004
Sud05	Sudan	Comprehensive Peace Agreement between the Government of Sudan and the SPLM/SPLA	09-Jan-2005
Ins05	Indonesia	Memorandum of Understanding between the Government of the Republic of Indonesia and the Free Aceh Movement	15-Aug-2005
Nep06	Nepal	Comprehensive Peace Accord Signed between Nepal Government and the Communist Party of Nepal (Maoist)	22-Nov-2006
Ivo07	Côte d'Ivoire	Accord politique de Ouagadougou	04-Mar-2007

Appendix 2: Analysis of Necessary Conditions for the SCNPT[8]

Condition	Cons.Nec	Cov.Nec	RoN
PS	0.674	0.679	0.642
TJ	0.498	0.817	0.895
TR	0.675	0.770	0.773
IA	0.753	0.694	0.591
IP	0.734	0.842	0.834

Necessary_disjunctions	incIN	RoN	covN
~PS + TJ + ~IA + IP	0.904	0.584	0.767
~PS + ~TR + ~IA + IP	0.906	0.571	0.762
~PS + TR + ~IA + IP	0.910	0.521	0.744
TJ + ~TR + ~IA + IP	0.908	0.516	0.740

8 Cons.Nec, incN = consistency for necessity; Cov.Nec, covN = coverage for necessity; RoN = relevance of necessity; "~" denotes the negation of a condition; "+" for the logical OR.