b
UNIVERSITÄT
BERN

OESCHGER CENTRE
CLIMATE CHANGE RESEARCH

Master Thesis
Faculty of Science, University of Bern
Oeschger Centre for Climate Change Research[1]; Institute for Political Science
University of Bern[2]

Indexing Vertical Policy Harmonization in the Two-Level Climate Change Regime

Author:
Jack Baker[1,2]
Cand. MSc. in Climate Sciences with Special Qualification in Social Sciences

Supervisor:
Prof. Dr. Karin Ingold[1,2]

Advisor:
Dr. Marlene Kammerer[1,2]

August 24, 2020

Table of Contents

List of Figures and Tables

1. Introduction

The potential of certain gases to block infrared radiation and warm the earth's atmosphere was first recognized by John Tyndall in 1861 (Stutter 2017). Since then scientists have continued to collect evidence of increasing concentrations of greenhouse gases and a changing climate driven by human activity. With increasingly clear evidence, the concerted effort to address anthropogenic climate change at the global level began at the World Climate Conference in 1979 (Gupta 2010) and was later formalized with the establishment of scientific and political bodies in the United Nations – namely the Intergovernmental Panel on Climate Change (IPCC) and the Framework Convention on Climate Change (UNFCCC). Despite this, climate change has proven to be politically difficult given its complexity, scale and uncertainty. Understanding the complexity of climate change involves both the underlying physics and the structural transformation required to effectively address it. It's scale is abstract and overwhelming as it spans physical and temporal bounds that is beyond our own immediacy – physical in the sense that the climate is composed of complex interactions between atmospheric, terrestrial and marine systems and temporal as the actions of the past have influenced our present climate just as our actions today will determine the climate of future generations. It is uncertain because humanity only knows the stability of the Holocene and it is unsure how our systems will adapt to the more frequent and more severe weather events that are already being seen throughout the world (Cruzten & Stoermer 2000). Through these characterizations, it can be seen that tackling climate change requires mobilizing every corner of society – from individuals and communities to corporations, national governments and intergovernmental organizations (IGOs).

The mobilization of climate action at the global level has continued to evolve since 1979. In the foundational, agenda-setting and pre-negotiation phases the issue of climate changed emerged first in the scientific community but was quickly taken up as a political issue (Bodansky and Rajamini 2018). The following phases include the adoption of the UNFCCC in 1992 and the beginning of major developments in the global climate change regime (Bodansky and Rajamini 2018). In 1997, developed countries committed to reducing emissions of CO_2 and other greenhouse gases (GHGs) in the Kyoto Protocol. At

the onset of the next century, the development of the global climate change regime experienced a setback with the United States and Canada withdrawing from the Kyoto Protocol. Nevertheless, negotiations for a second commitment period under the Kyoto Protocol took place in 2005 and was followed by the Bali Action Plan in 2007 that commenced new negotiations under the UNFCCC. In this phase, the global climate change regime was reimagined in the Copenhagen Accord with voluntary pledges and transparency as its cornerstones (Bodansky and Rajamini 2018). Although widely deemed as a failure, its measures were formally integrated into the UNFCCC process with the Cancun Agreements in 2010. These developments culminated on December 12th, 2015 when the Paris Agreement was adopted by 175 Parties, or countries, at the 21st Conference of Parties (COP 21) in Paris. This agreement committed the Parties to limiting global temperature rise to 1.5˚C above pre-industrial levels (Paris Agreement 2015) while recognizing Parties' common but differentiated responsibility (CBDR) in mitigating climate change.

At the center of the Paris Agreement are nationally determined contributions (NDCs) and the so-called "ratchet mechanism" (Yeo 2016). In the NDCs, each country establishes their own targets to and means of reducing GHG emissions given their country's characteristics and capacity. NDCs, or rather intended NDCs (INDCs), were first communicated to the UNFCCC process in the run up to COP 21. Following the Paris Agreement, the Parties convene every five years to review their collective progress and communicate their commitments for the next five-year period with expectation of increasing ambition overtime – i.e. the ratchet mechanism (Bodansky and Rajamani 2018). The bottom-up approach of the Paris Agreement is an attempt to circumnavigate political obstacles – e.g. the translation of international positions to effective domestic policy, or the friction between developed and developing countries (also referred to as the north-south divide) – that have plagued the international climate regime for the past three decades. The primary focus of this thesis examines the former obstacle – i.e. translating international positions to actionable and effective policy back home.

The gap between commitments made at COPs and laws that are implemented domestically falls squarely within Putnam's (1988) "two-level game", in which delegates

must reconcile the interests of other countries with an agreement that would be feasible to ratify domestically. The two-level game literature bridges the divide between international relations and comparative politics by considering both interstate variation and systematic conditions in explaining outcomes at both the international and domestic levels (da Conceição-Heldt & Mello 2017). The synthesis of the subdisciplines' approaches is particularly evident in studies analyzing the outcomes of negotiations and policymaking processes in the climate change regime (e.g. Weiler 2012). Scholars in this area, and more broadly in foreign policy analysis, recognize the complexity of aligning the two levels and seek to explain occurrences of (mis)alignment between the two levels by analyzing various underlying factors, such as bargaining strategies (e.g. Hovi et al. 2012) or countries' structural and economic characteristics (e.g. Bättig & Bernauer 2009; Michaelowa & Michaelowa 2015). Nevertheless, this established body of literature continues to lack a systematic approach that measures the (dis)harmony between the two levels. That being said, future research in the Swiss Network for International Studies (SNIS) project C20035[1] aims at advancing the two- and multi-level literature by enriching the understanding of the intersection of international and national interests, in addition to developing a robust method for measuring the degree of harmonization, or lack thereof, between the two levels. As such, this thesis aims to contribute to the SNIS project and the literature, by pursing two objectives. First, to develop an index to measure the level of vertical policy harmonization in the context of climate change mitigation. And second, to examine the effect of macro-level conditions[2] of a country on the level of harmonization between international positions and national policies. As such, and in line with aims of the SNIS project, the research question reads as:

> Which macro-level conditions, and the combinations thereof, increase or decrease the likelihood of countries to harmonize their international positions or commitments and their national strategies, plans and policies?

[1] SNIS (C20035): Policy and Politics in the multi-level climate change regime
[2] Macro-level conditions can also be understood as macro-level factors or a country's general characteristics – e.g. system of governance or its gross domestic product.

Furthermore, I address this question by the way of qualitative comparative analysis (QCA) – examining the influence of democracy, corporatism, vulnerability and abatement costs on vertical policy harmonization. Before continuing with the next sections, two caveats of this analysis should be briefly addressed. First, I do not argue that only macro-level conditions can influence this (mis-)alignment, but rather I am stating the focus of my investigation rests on macro-level factors. Moreover, by selecting the above macro-level conditions, I do not assert that these are the only ones that matter; this is discussed further in *Sections 3* and *7.2*. Second, collective climate governance includes the international and domestic arenas, both comprised of actors other than formal national governments (e.g. cities, states, multi-national corporations, non-governmental organizations) that interact with one another in various venues. As such, the climate change regime can also be described as being transnational (e.g. Betsill & Bulkeley 2004), multi-level (e.g. Jänicke 2017) or polycentric (e.g. Jordan et al. 2017; Ostrom 2012). While this is in fact true, the focus of this thesis and its level of analysis remain within Putnam's two-level characterization of international relations and applies it to the climate change regime; this will be further discussed in next section.

This thesis is structured as follows: The following section introduces the theoretical and empirical foundations of the two-level game, policy instruments and output, policy harmonization and measuring climate performance. The third section introduces the hypotheses as sufficient or necessary conditions needed for the expected outcome to occur. The fourth section describes the data and its sources, in addition to the development and measures of the Vertical Policy Harmonization Index (VPHI). The fifth section presents the Qualitative Comparative Analysis (QCA) method and how its fuzzy set variant (fsQCA) will be applied to address the research question. The sixth section presents the results from this analysis and its support, or lack thereof, for the hypotheses. The seventh section presents a discussion of the VPHI's limitations, suggestions for future iterations and key findings in addressing the research question via the QCA method. Finally, this thesis concludes with an eighth chapter reviewing the key findings and implications of the VPHI and the application of the QCA method. The sections of this thesis are accompanied by an appendix and an adjoining codebook.

2. Background

This section begins with a brief introduction of Putnam's two-level game, its developments since and its application to climate policymaking process. Following this, the definitions of policy instruments and policy output are presented, the theoretical foundations of policy harmonization are discussed and is differentiated from similar assimilative mechanisms. Finally, this section presents the empirical work in measuring climate policy and climate (policy) performance, which serves as the methodological infrastructure of the VPHI.

2.1 The Two-level Game and Beyond

Scholars have sought to explain the difficulty of governing climate change in terms of its characteristics and the inability of international regimes to enforce strict and binding agreements on sovereign states. The interactions of international regimes and sovereign states involves the interplay of international and domestic interests and policy. This interplay, and its constraints, is best captured by Putnam's two-level game (1988). In this game, negotiators must reconcile the interests of other countries with an agreement that would be ratifiable at the domestic level given the constraints and interests at that level (see *Figure 1*). To do so negotiators have to find their "win-set" – i.e. the set of outcomes of the international negotiations that is agreeable to all parties involved and is determined to win ratification domestically. Overlapping win-sets are essential to the successful negotiation of international agreements at "Level 1", though this does not imply that the agreement will be ratified at the national level, "Level 2" (Avery 1988; Putnam 1988).

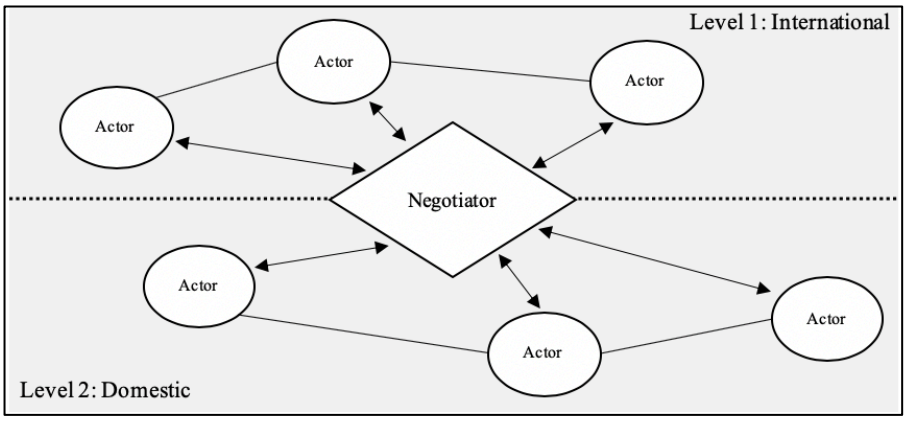


Figure 1. Putnam's two-level game; own illustration.

Since Putnam's initial publication of the two-level game in 1988, the discussion of its merits has coalesced around its level of analysis, the role of domestic institutions, the interactions between the domestic and international levels, and the relevant actors and their interests (da Conceição-Heldt & Mello 2017). Here, we will focus on the first aspect, the level of analysis. In their comprehensive literature review of the two-level game in foreign policy analysis, da Conceição-Heldt and Mello (2017) concluded that one level is not always superior to the other – i.e. interests and outcomes at the international level do not always dictate those at the domestic level and vice versa. Furthermore, the two-level game has helped bridge the gap between the studies of international relations and comparative politics that have traditionally been segregated (da Conceição-Heldt & Mello 2017). The explanatory power of both fields has been siloed by their inability to link their levels of analysis. That is, international relations sought to explain outcomes only with systemic conditions whereas comparative politics relied on the variation within states without including the international system in its analysis (da Conceição-Heldt & Mello 2017). Finally, da Conceição-Heldt and Mello (2017) note that the complexity of the international-domestic interplay is not limited to just two levels and that there is at least a third – the transnational level – as there are actors that span both levels (e.g. multinational corporations, nongovernmental organizations).

Beyond the two-level game is the study of transnational, multi-level and polycentric governance in negotiating and implementing multilateral agreements. Each of these perspectives acknowledges that the conventional perception of a top-down approach in global environmental regimes, where nation-states come to an agreement at the international stage and direct domestic implementation, is outdated and excludes the interactions and presence of different actors at different levels (Bulkeley & Bestill 2003). That is, global regimes are not limited to national governments operating between two-levels but is comprised of interactions between and among governmental and non-governmental actors from the local to global levels. In the transnational perspective, the organization of actors' interactions in networks, such as the Cities for Climate Protection, promote policy learning and play an important role in establishing and maintaining global regimes (Bestill & Bulkeley 2004). Transcending the two-level game even further is multi-level governance, in which a diverse set of actors operate across both vertical and

horizontal dimensions – i.e. business, civil society, and state actors are present and participate at all levels and across all sectors (Bache & Flinders 2004; Marks 1993). Along these same lines, a governance system is characterized as being polycentric, "when multiple public and private organizations at multiple scales jointly affect collective benefits and costs" (Ostrom 2012, p. 355). While in theory and in practice, the development and processes of the global climate change regime are more accurately classified within these perspectives as tackling climate change requires the collective action of numerous actors across all levels and sectors, I remain within the two-level characterization in this thesis and its empirical study. I justify this limitation given the methodological approach to measuring vertical policy harmonization – i.e. I take the difference between international and national commitments communicated by national governments and do not consider the pledges of subnational governments, businesses or civil society organizations.

In analyzing the climate policymaking process, numerous studies have applied the two-level metaphor, either explicitly or implicitly. Some have sought to explain cooperation and compliance, or the lack thereof, by the way of a country's characteristics (e.g. Sprinz and Vaahtoranta 1994; Bättig & Bernauer 2009), while others have focused on the gap or alignment of interests and policies between the domestic and international levels (e.g. Hovi et al. 2012; Sprinz & Weiß 2001). Bringing these aspects together are the studies of Jordaan et al. (2019), Upadhyaya et al. (2018) and Michaelowa & Michaelowa (2015). Jordaan et al. (2019) studies the discrepancies between international and national climate policies in federalist systems. Upadhyaya et al. (2018) presents factors that determined the domestic application of Nationally Appropriate Mitigation Actions (NAMAs) in the cases of India, Brazil and South Africa. Finally, Michaelowa & Michaelowa (2015) study whether or not developing countries' rapid economic growth influences their support for increasing their responsibility for emissions mitigation in the UNFCCC process; they found that these countries prefer to implement domestic policies as opposed to committing to binding targets at the international level. These are referenced to highlight the prevalence of studies that employ Putnam's two-level game in examining the problem of aligning the domestic and international levels within the climate change regime. Despite this, an empirical measurement of this problem has yet to be developed. In this

context, this thesis aims to contribute to this body of literature by constructing the first index to measure the level of (mis)alignment between the domestic and international levels.

2.2 Policy Instruments and Policy Output

Before presenting the concept of policy harmonization and differentiating it from other assimilative mechanisms, it is prudent to first discuss the conceptualization of policy and the role of policy instruments. In its simplest definition, a policy[3] is a government's decision to act, or not, in altering the status quo (Dye 1972; Howlett & Cashore 2014). More specifically, a policy is, "a set of interrelated decisions taken by a political actor or group of actors concerning the selection of goals and the means of achieving them within a specified situation" (Howlett & Cashore 2014, p. 19). That is, a policy is comprised of ends and means to reach those ends, both operating from the most abstract level to program operationalization and specific, "on-the-ground" settings (Howlett 2009, p. 75).

Howlett and Cashore (2009) further conceptualize policy, at various levels of abstraction, as being comprised of goals, objectives and requirements in its ends, and instrument logic, mechanisms and calibration in its means – see *Table A* in the appendix for a description of each component. At the center of this conceptualization are policy instruments (Schaffrin et al. 2015) that transfer goals from the abstract, macro-level into substantive action effectuating the desired change in behavior (May 2003). Policy instruments can take the form of regulatory measures compelling certain behavior (e.g. energy performance standards), soft instruments providing information and outreach (e.g. training programs), market-based approaches incentivizing certain behavior (e.g. feed-in tariffs), framework regulation to guide policy development and implementation, or public investments (Schaffrin et al. 2015, p. 282). Furthermore, a government can adopt a mixture of these in attempt to materialize its policy goals.

[3] Here, I refer to public policy. While private organizations can create and implement policies that affect their own members, this definition refers to policy that is public in nature – i.e. made by governmental bodies that affect all those within a given body's jurisdiction (Howlett & Cashore 2014).

In its definition, policy output is similar, if not identical, to the definition of policy presented above. Policy output is described as the, "actions of policy decisions of governments results from the policy process in which political actors interact, communicate, and bargain within a set of formal and informal procedures, rules and institutions" (Schaffrin et al. 2015, p. 258). Furthermore, Schaffrin et al. (2015) hold the perspective that policy instruments are the central tenant to policy output and provide an avenue for comparing policy across different dimensions, such as time or policy fields. In operationalizing the comparison of policy instruments, and thus policy output, Knill et al. (2012) suggested a combined assessment of policy density – i.e. the number of policy instruments – and policy intensity. Albrecht and Arts (2005) define policy intensity as the, "organization and mobilization of resources" given to a specific policy instrument (p. 888). It can be generally thought of as the quality of a policy's content and is assessed by utilized the intensity measures – *Objective*, *Scope*, *Integration*, *Budget*, *Implementation*, and *Monitoring* – proposed by Schaffrin et al. (2015). These intensity measures and their use in the construction of the VPHI are discussed in *Sections 4.2*.

2.3 Policy Harmonization

The study of assimilative mechanisms in the process of policy innovation is commonplace in political sciences, particularly in the governance of environmental issues (e.g. Carley & Miller 2012; Holzinger et al. 2012). In this context, I use the term assimilative mechanism to broadly refer to the concepts, among others, of policy diffusion, convergence, and harmonization. These mechanisms are synonymous in that they facilitate the adoption of instruments, structures and processes across domains, but diverge from one another in regard to why or how policy innovation takes place. Diffusion is, "the process by which an innovation is communicated through certain channels over time among members of a social system" (Rogers 1983, p. 6). Applying this social phenomenon to policy innovation, Eyestone (1977) describes diffusion as, "any pattern of successive adoptions" (p. 441). In a broad sense, convergence is defined as, "the tendency of societies to grow more alike, to develop similarities in structures, processes and performances" (Kerr 1983, p. 3). In the context of policy innovation, refers to the inclination of policies becoming more similar in their goals, content, instruments,

outcomes or style (Bennet 1991). Moreover, Bennet (1991) states that policy convergence can be triggered by emulation[4], elite networking in transnational policy communities, participation in international regimes and the presence of external actors and interests. Moving to policy harmonization, Majone (2014) defines it as, "making the regulatory requirements or governmental policies of different jurisdictions identical or at least similar" (p. 4). Here it can be seen that each concept is referring to the adoption of a policy or practice that moves separate domains in a similar direction.

Why is policy harmonization the focus in the context of this thesis as opposed to its synonymous concepts? In order to spell this out and differentiate policy harmonization from the others, let us return to Putnam's two-level metaphor. In the two-level game, playing both levels is inherently a complex task as, "moves that are rational for a player at one board…may be impolitic for that same player at the other board" (Putnam, 1988, p. 434). Following this, Putnam (1988) suggests that it is in the best interest of the negotiator to align the positions at Level 1 and with the interests at Level 2, and vice versa. This call for alignment is an intrastate homogenization of interests – i.e. the alignment must take place within a country's apparatus and not across the broader system (e.g. the Parties in the UNFCCC). Though Majone's definition of policy harmonization is not limited to the vertical axis of increasing jurisdictional similarity, the concepts of policy convergence and diffusion are horizontally limited as they imply the adoption of policy innovation across a broader social system (Bennett 1991; Rogers 1983). For these reasons – the verticality of Putnam's call for alignment and the limited dimensions of policy convergence and diffusion – policy harmonization is the most suited lens to study the gap between international positions and national policies in climate mitigation.

2.4 Measuring Climate Policy Performance

There exists in the literature multiple studies that analyze the policy effort and performance of countries in addressing climate change – namely the Index of Climate Policy Activity (ICPA), the Climate Change Performance Index (CCPI), the Climate Action Tracker (CAT) and the Climate Change Cooperation Index (C3-I). On one hand,

[4] Emulation is when, "state officials copy action taken elsewhere", and apply it within their own jurisdiction (Bennet 1991, p. 215).

the CCPI, the CAT and the C3-I produce comparative measurements of policy performance in terms of policy outcome and output.[5] On the other, the ICPA focuses on applying a standardized method of measuring policy output. In the context of this thesis, the ICPA's approach to measuring policy output is adapted in the construct of the harmonization index and the CCPI and CAT serve as reference indices in the validation process of the index presented in this thesis.

Recognizing the lack of a standard method to produce comparative measurements of policy output in climate politics, Schaffrin et al. (2015) propose an approach for its operationalization and apply it in the Index of Climate Policy Activity (ICPA). In this index, the authors evaluate the policy instruments in the energy sectors of Austria, Germany and the United Kingdom. According to Knill et al. (2012), policy output is a function of policy density and intensity. The former aspect is simply the sum of policy instruments, whereas the latter is assessed by examining the amount of resources, time, and effort that are given to a specific policy instrument (Schaffrin et al. 2015). Specifically, Schaffrin et al. (2015) develop six measures of policy intensity – *objective*, *scope*, *integration*, *budget*, *implementation*, and *monitoring*. These measures are meant to capture the intensity of a policy instrument over different stages of the policy process, from agenda setting and formulation to implementation and evaluation (Schaffrin et al 2015). The measures are applied to a policy by evaluating the different coding questions of each intensity measure against the policy's content (see *Table B* in the appendix).

The CCPI scores the climate performance of 56 countries and the European Union (EU) that account for 90% of global GHG emissions with the aim of increasing transparency and political pressure (Burck et al. 2018). A country's composite score is produced by evaluating 14 indicators across four categories – GHG emissions, renewable energy, energy use and climate policy, as shown in *Figure 2*. The final score reflects a country's policy outcome and output relative to that of other countries. The score of each category is weighted, with GHG emissions determining 40% of the score with the reason that achieving reductions is the most important aspect of addressing climate change (Burck et

[5] In the context of climate mitigation, policy outcome is the measurable impact of a policy (e.g. reducing GHG emissions) whereas policy output is the political commitment to mitigating climate change.

al. 2018). The remaining categories are equally weighted at 20% of the composite scores; the authors hope that these weights avoid misrepresenting the achievement and ambition of countries with varying levels of historic responsibility and rates of economic growth.

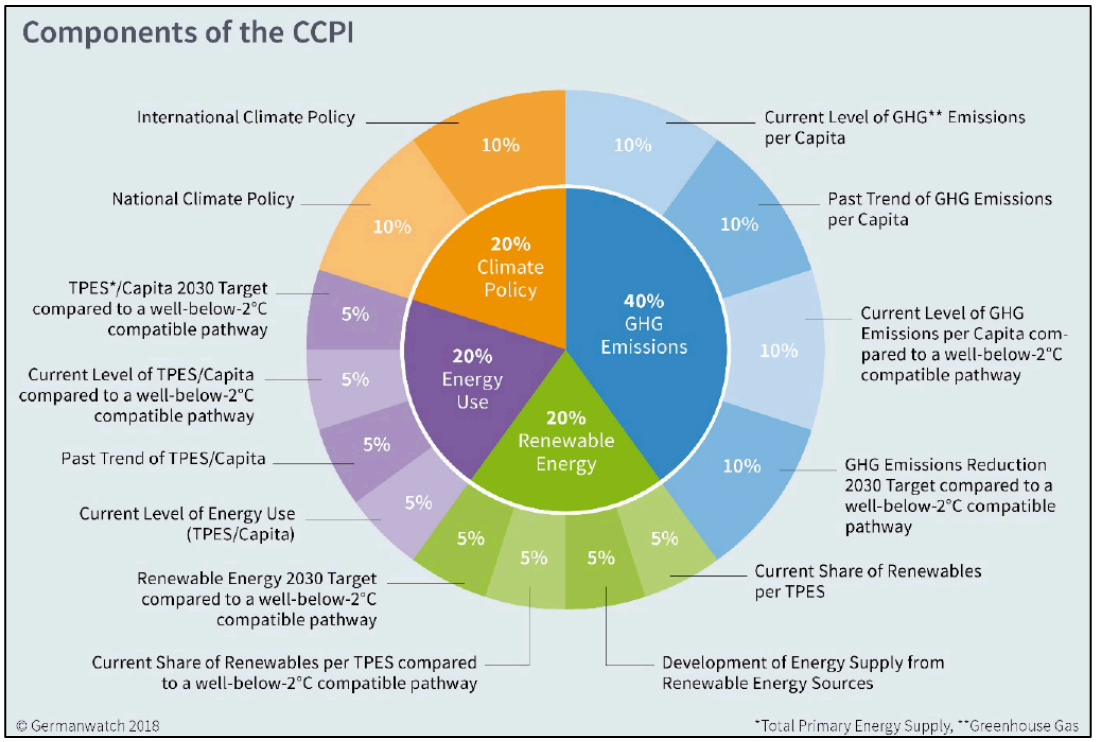


Figure 2. Components of the Climate Change Performance Index. (source: Burck et al. 2018)

The Climate Action Tracker (CAT) questions whether or not the cumulative effect of current commitments is consistent with the Paris Agreement – i.e. are they sufficient in limiting average global warming to 1.5˚C? In answering this question, the CAT uses a "fair share" rating system to assess the (I)NDCs of countries based on, "what a country's total contribution would need to be to make a fair contribution to implementing the Paris Agreement" (Climate Action Tracker 2020, *Comparability of Effort*). In evaluating (I)NDCs, the CAT considers a country's historical and future emission levels as well as the stipulated mitigation target. These ratings focus on the international pledges of the Copenhagen Accord, the Cancun Agreements, and the Paris Agreement; the latter is the subject of its most recent report. This index produces categorical evaluations of pledges

and (I)NDCs and rates them from critically insufficient to role model in relation to the goals of the Paris Agreement.

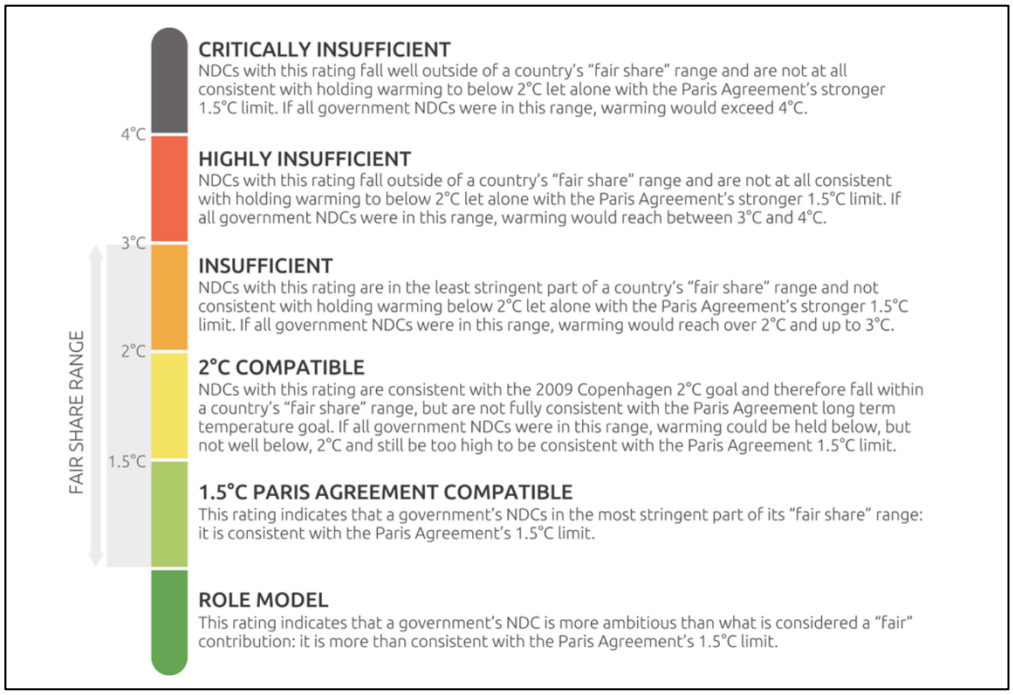


Figure 3. The fair share rating system of Climate Action Tracker. (source: Climate Action Tracker 2020)

The Climate Change Cooperation Index (C3-I) is similar to the CCPI in that it measures the climate performance of countries in terms of policy output and outcome. In fact, Bernauer and Böhmelt (2013) note the similarity of their index and the CCPI but make the distinction in their methodological approach. First, the C3-I does not rely on expert assessments to inform their calculation of climate policy score, see *Section 7.1*. Second, the C3-I weights policy output and outcome evenly in the final aggregation of a country's climate performance, whereas the CCPI allocates more weight to emission levels (see *Figure 2*). In addition to this, the Bernauer and Böhmelt widen the coverage of the C3-I by looking at 172 countries over 12 years. Despite being relevant, the C3-1 was not used as a reference index in validating the VPHI, this is discussed briefly in *Section 7.1*.

Despite the considerable contributions of these indices in measuring climate performance, they offer only an avenue for inter-comparative analysis. That is, they are constructed with the aim to compare scores across countries and do not go forward in making intra-

comparisons. Although it would be possible to make comparisons within countries by taking the separate performance scores of international and national policies in the CCPI and CPI-3 indices, they do not. In this way, the Vertical Policy Harmonization Index builds on the ICPA and goes forward with constructing an index tailored for comparing international and national climate policy output within countries while referring to the results of the CCPI and the CAT for validation.

3. Casual Conditions and Vertical Policy Harmonization

In this thesis, the study of the drivers of vertical policy harmonization is set at the macro-level. This level is the chosen unit of analysis given that the variables of interests, or conditions, preside at the macro-level, the focus of macro-level comparative analyses and the potential limitations of findings at the meso-and micro-levels.

First, the outcome (the key variable of interest) of vertical policy harmonization is constructed by finding the difference between international commitments and national strategies, plans and policies, both of which originate at the macro-level. However, that is not to say, that they do not incorporate interests from the meso- and micro-levels. Second, the possible number of cases and their level of commonality is limited at the macro-level (Berg-Schlosser & Quenter 1996). Even if all cases at the macro-level are considered in a given analysis, this would number at approximately 195 sovereign countries (United Nations n.d.). Despite the relatively limited sample size in macro-analyses, "these systems and the interactions which are taken into account in the analysis exhibit a high level of complexity" (Berg-Schlosser & Quenter 1996, p. 4). This tradeoff, that is between the limited number of cases and the level of commonality and complexity, facilitates a focused investigation of systematic conditions and outcomes. Third, findings at the micro- and meso-levels would remain rudimentary without a macro-level frame (de Munck 1994) and would not shed much light on the systematic conditions affecting vertical policy harmonization. That is, findings at the micro-level can be limited in their ability to be generalized and extrapolated over time and across systems (Teune 1977). On the other hand, the comparability of findings at the macro-level facilitate the confirmation, or lack thereof, of the relationship between systematic conditions and vertical policy harmonization.

That being said, findings at the micro- and meso-levels are not being wholly labeled as ineffectual and could contribute to the discussion of the interplay between international and national interests in the context of climate mitigation policymaking processes. However, within this thesis the unit of analysis remains within the macro-level but could widen to include the other levels in the future research of the SNIS project.

In studying the drivers of vertical policy harmonization, the conditions presented in the following subsections were selected as a large body of literature exists that examines how they affect macro-level performance in terms of countries' cooperation in international regimes and variation in environmental or climate outcomes (e.g. Li and Reuveny 2006; Jänicke 1996; Sprinz and Vaahtoranta 1994). That is, given the established empirical relationships between the conditions in the context of macro-level performance, it is expected that these conditions will also demonstrate an empirical influence on levels of vertical policy harmonization. Furthermore, Bailer and Weiler (2015) have determined that a country's negotiation position in climate negotiations is a function of its structural characteristics (e.g. political system), geographic setting (i.e. vulnerability to climate change), economic status and strategic interests (i.e. position in the international community). Similarly, Castro et al. (2014) demonstrate that membership to the Annex I or non-Annex I groups influences negotiation behavior. These studies justify the selection of democracy, the system of interest representation, vulnerability and abatement costs as the conditions of interest in this thesis. That being said, these are not the only systemic conditions of interest; as discussed in *Section 7.2* additional conditions will be considered in future research within my doctoral studies and the SNIS project.

3.1 Condition 1: Democracy

The effect of democracy on the provision of public goods, including environmental quality, is consolidated under the democracy-environment hypothesis. The findings of multiple studies have been mixed as some found that democracy has a positive effect on the provision of public goods (Ward 2008; Neumayer 2002; and Li and Reuveny 2006), while others argue that the "democracy effect" remains ambiguous or even negative (Congleton 1992; and Midlarsky 1998). As the climate can be understood as a public good and its provision includes the prevention of its exploitation (Ostrom 1999), the

democracy-environment hypothesis can be extended to climate change mitigation. Following this, Bättig and Bernauer (2009) found that the level of democracy has a positive effect on policy output in the climate change regime – i.e. democratic countries exhibit higher levels of political commitment to climate change mitigation. While this may be the case in the context of political commitment and the provision of public goods, the opposite is anticipated in regard to vertical policy harmonization. In fact, Tubi et al. (2012) found that democracy has a negative effect on policy implementation; that is, "while [democracy] contributes to political commitment it might also hinder its translation to emissions reductions" (p. 478).

Against this background and the institutional constraints of democratic systems – e.g. its myopic nature, the necessity to satisfy diverse domestic pressures – it is expected that democracies will exhibit lower levels of policy harmonization. Conversely, it is anticipated that autocracies will have higher levels of harmonization as autocratic regimes need only to satisfy the preferences of a small elite to insure political survival and experience less or perhaps no pressure at the domestic table (Bättig & Bernauer, 2009). In the words of Putnam's two-table metaphor, political leaders in democracies have to satisfy or reconcile preferences at both tables, whereas autocratic leaders can focus primarily on the international table given the lack of constraints and pressure at the domestic table. Hence, the first hypothesis is:

> H_1: Democracy and its institutional constraints tend to make it difficult to harmonize international positions and domestic policies. Thus, the presence of autocratic characteristics is a sufficient condition for higher levels of vertical policy harmonization.

3.2 Condition 2: System of interest representation

How interests groups are represented and integrated into a country's institutional structure falls on a spectrum, with corporatism at one end and pluralism at the other.[6] Though a strict definition of corporatism lacks (Lijphart 1999), corporatist systems are characterized as, "a system of interest representation in which a small number of strategic actors (usually representatives of capital and labour), organised in peak associations, represent large parts of the population in an encompassing fashion" (Crepaz 1995, p. 391). Furthermore, corporatism is associated with a goal-oriented, consensual decision-making process underlined by the absence of zero-sum thinking (Fiorino 2011; Neumayer 2003; Lijphart 1999). Opposite of corporatism are pluralist systems with a large number of small interest groups, often with competing interests, that vie to influence the legislative agenda (Scruggs 1999). Scruggs (1999) notes that this often leads to a heavily contested policy process, from agenda-setting to implementation. Although corporatism and pluralism offer distinct approaches to interest intermediation (Scruggs 1999), Lijphart (1999) states that, "pure pluralism and pure corporatism are rare, and most democracies can be found somewhere on the continuum between the pure types" (p. 159).

In the latter quarter of the 20th century, numerous studies evidenced the positive effect of corporatist structures on inflation, rates of unemployment and economic growth (e.g. Wilesnky and Turner 1987; Schott 1984; Hicks 1988). With due time, corporatist literature extended to study environmental outcomes and asked whether or not corporatism and its counterpart, could help explain variation in countries' environmental performance. From the beginning, environmental advocates argued that traditional corporatist groups – i.e. labor and capital – are intrinsically opposed to environmental reform and are, "structurally incapable of incorporating new ecological issues to achieve major policy change" (Scruggs 1999, p. 4). Offe (1981) echoes these concerns, arguing that the major interest groups in corporatist arrangements dismiss interests that are peripheral to their own.

[6] As Lijphart (1999) states, "Corporatism is often also termed "democratic corporatism," "societal corporatism," or "neocorporatism" to distinguish it from authoritarian forms of corporatism in which interest groups are entirely controlled by the state. I shall use the short term "corporatism" but always as a synonym of democratic corporatism" (p. 158).

Despite these criticisms, the empirical findings of numerous studies point towards corporatist arrangements increasing environmental performance (e.g. Crepaz 1995; Jahn 1998; Lieferink et al. 2009), though, "the way in which we measure environmental effectiveness is important and may influence our results" (Poloni-Staudinger 2008, p. 419). Nevertheless, it is argued that corporatist systems effectuate higher levels of environmental performance. First, corporatist systems are better outfitted in gaining and using information regarding policy options, costs and impacts of alternatives; second, there tends to be higher levels of trust between regulators and the regulated which facilitates flexible implementation, and finally corporatist structures can organize interests more comprehensively (Fiorino 2011). From here I diverge from the literature on the efficacy of corporatism in increasing environmental performance but continue to focus on the ability of corporatist structures to hierarchically organize interests into peak organizations and how this effects vertical policy harmonization.

Scruggs (1999) suggests that corporatism is better suited at providing public goods as evidenced in the literature and subsequent empirical studies. The high levels of interest intermediation and policy concentration that characterize corporatism help overcome collective-action problems (Scruggs 1999); at the same time, "a competitive, pluralistic system of interest intermediation may be worse, exhibiting severe co-ordination and enforcement problems in society" (Scruggs 2001, p. 687). That is to say, corporatist structures are able to organize diverse interests into an aggregated position that is taken up by peak organizations that coordinate frequently with one another and with policymakers at various points of the policy process (Scruggs 1999). Here lies the heart of the argument – peak organization consolidate diverse and maybe even competing interests, making it easier for governments to develop policies that satisfy those interests. To elicit Putnam's two-level game, negotiators of corporatist systems will have to respond to a limited number of domestic interests, as opposed a negotiator of a pluralist system which will, "receive input from a number of small, often competing, interest groups, and makes policy that is some vector of clashing interests" (Scruggs 1999, p. 3). To summarize, the characteristics of corporatism, as laid out above, will enable countries to better align their international and domestic interests in mitigating climate change. Thus, the second hypothesis:

H_2: Democracies with corporatist systems of interest representation efficiently organize interests and overcome collective action problems. As such, democracy and corporatism is a sufficient combination of conditions for higher levels of vertical policy harmonization.

3.3 Conditions 3 and 4: Vulnerability and Abatement Costs

Finally, it is expected that a country's vulnerability[7] in combination with abatement costs – i.e. the economic costs of mitigating climate change – shapes the degree of vertical policy harmonization. In terms of political commitment, Sprinz and Vaahtoranta (1994) suggest that countries will push for ambitious international mitigation measures if they face low abatement costs and are highly vulnerable; conversely, countries that face high abatement costs and are not highly vulnerable do not favor ambitious international measures – see *Figure 4*. It should be noted that adaptive capacity, the role of expert knowledge and the use of abatement technology also play a role in countries' level of political commitment (Tubi et al. 2012; Sprinz and Vaahtronta 1996), but these fall outside the purview of the argument made, within the context of this thesis, given the complexity of gathering this data and operationalizing these additional conditions for each country.

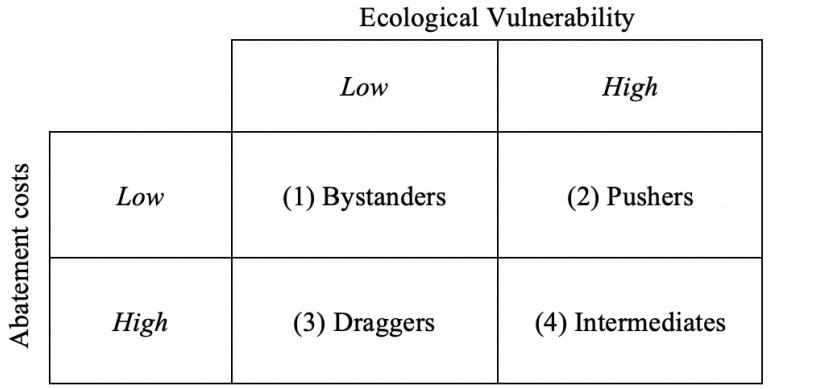


Figure 4. Classification of countries' political commitment to international regulations. (source: Sprinz and Vaahtoranta 1994).

[7] Vulnerability, as defined by the IPCC in the Fourth Assessment Report (AR4), is, "the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change" (p. 6) and is comprised of exposure, sensitivity and adaptive capacity (IPCC, 2007).

In examining the Montreal and Helsinki Protocols, Sprinz and Vaahtoranta (1994) found that only pushers – see the second quadrant in *Figure 4* – behaved as expected. These countries recognized that international measures are more effective than unilateral action and did not want to jeopardize the competitiveness of its industries on the international market (Sprinz and Vaahtoranta 1994). It is expected that the configurations of low/high abatement costs and low/high vulnerability translate from context of political commitment to vertical policy harmonization. This argument is made with the assumption that the level of adaptive capacity, expert knowledge and use of abatement technology is equal across all cases. As such, the third hypothesis is:

> H_3: High vulnerability and low abatement costs is a sufficient combination of conditions for higher levels of vertical policy harmonization.

As explained in *Section 4.1*, emissions intensity – i.e. GHG emissions per unit of gross domestic product – is used as a proxy for abatement costs; the more intense a country's emissions are, the more costly it is to abate them.

4. Data

This section presents the data, its sources, the operationalization of international and national policy output in the development of the Vertical Policy Harmonization Index, and the procedure implemented to ascertain the validity of the index by comparing different aspects of the VPHI to the reference indices. This section closes with the measurements of vertical policy harmonization – the key dependent variable in this study – and whether or not its construction is validated in relation to the other indices.

4.1 Data Sources & Case Selection

Data required for this report will be drawn from various sources, as shown in *Table 1*. The two primary sources for the VPHI are the Interim NDC Registry provided by the UNFCCC and London School of Economics (LSE) Grantham Research Institute's Climate Change Laws of the World; the Asia Pacific Energy Portal was consulted for texts that were not available in English. Data for the macro-level conditions is drawn from the World Resources Institute (WRI) CAIT Climate Data Explorer, the PolityIV dataset

from the Center for Systemic Peace, the World Economic Outlook Database from the International Monetary Fund (IMF), Germanwatch's Climate Risk Index and Jahn's (2014) study comparing different indices of corporatism. I rely on these sources given the credibility of the hosting institutions, their widespread citation in various bodies of literature, and their systematic organization of complex datasets in an accessible manner – i.e. their availability to the public in English and other world languages. These qualities help facilitate the transparency and replicability of this study.

Table 1. Data Sources

		Description	Source
Casual conditions / independent variables	Democracy	The polity2 score ranges from -10 (strongly autocratic) to 10 (strongly democratic). This is a modified version of the POLITY variable added in order to facilitate the use of the POLITY regime measure in time-series analyses.	Marshall et al. 2019
	Corporatism	Average scores (z-standardized) across Siaroff's, Hicks and Kenworty's (HK) and Jahn's indices of corporatism in 42 industrialized countries from 1960 to 2010.	Jahn 2014
	Abatement Costs	Total GHG emissions per unit of GDP. Used as a proxy for abatement costs. Unit: MtCO2/GDP (in million USD)	CAIT 2017
	Vulnerability	The level of exposure and vulnerability to extreme weather events in terms of fatalities and economic losses. Unit: Index score	Eckstein et al. 2018
Set outcome / key dependent variable	(I)NDCs	(Intended) nationally determined contributions submitted by Parties to the convention.	UNFCCC 2016; LSE 2018; Climate Action Tracker 2020
	National strategies, plans, policies	Laws, policies, or strategies to implemented at the national level to mitigate climate change.	LSE 2018; APEF 2013

Table 2 shows the cases selected for both the development of the VPH index and QCA method. The countries were selected on the basis of data availability and accessibility, while keeping in mind a representative sample with a diverse set of macro-level conditions. The sample consists of developed and developing countries, large and small GHG emitters, autocracies and democracies, and covers a wide range of group membership (Annex I, Non-Annex I, and negotiating blocs). While the last characteristic is not immediately relevant in this study, it may be pertinent in future research.

Table 2. Case Selection

	Country		Annex I	Non-Annex I	OECD	Negotiation group[1]
1	Australia	AUS	1		1	Umbrella Group
2	Brazil	BRA		1		BASIC, G77+C
3	Canada	CAN	1			Umbrella Group
4	China	CHN		1		LMDC, BASIC, G77+C
5	Germany	DEU	1		1	EU
6	India	IND		1		LMDC, CRN, BASIC, G77+C
7	Indonesia	INS		1		CRN, G77+C
8	Iran	IRN		1		LMDC, OPEC, G77+C
9	Japan	JPN	1		1	Umbrella Group
10	Korea, Republic of	KOR		1	1	EIG
11	Mexico	MEX		1	1	EIG
12	Russian Federation	RUS	1			Umbrella Group
13	South Africa	SAF		1		AG, BASIC, G77+C
14	Switzerland	CHE	1		1	EIG
15	Thailand	THI		1		CRN
16	Turkey	TUR	1		1	
17	United Kingdom	UKG	1		1	EU
18	United States	USA	1		1	Umbrella Group
		count	9	9	9	

[1]source: (Pearce and Yeo, 2015)

Figure 5 graphically displays the raw data of each macro-level condition; the cases are highlighted in blue. In this figure, it can be seen that the selected cases constitute a sample with a diverse set of macro-level conditions in relation to the complete raw dataset. Plot A in *Figure* 5 shows the level of democracy or autocracy in the PolityIV dataset, with 10 indicating a democratic state and -10 an autocratic state. Plot B indicates the level of

corporatism in country's system of interest representation, with higher values indicating corporatist structures and lower values pluralist systems. This dataset is the smallest with measures for only 42 countries, whereas the other datasets cover upwards of 160 countries. Plot C and D show the measures of climate vulnerability from the Climate Risk Index (Eckstein et al. 2018) and abatement costs as proxied by total GHG emissions per unit of GDP. The statistical summary of each dataset is listed to the right of each bar plot. The data – i.e. documents – taken into consideration for calculating countries' national policy output is listed in *Table C* in the appendix.

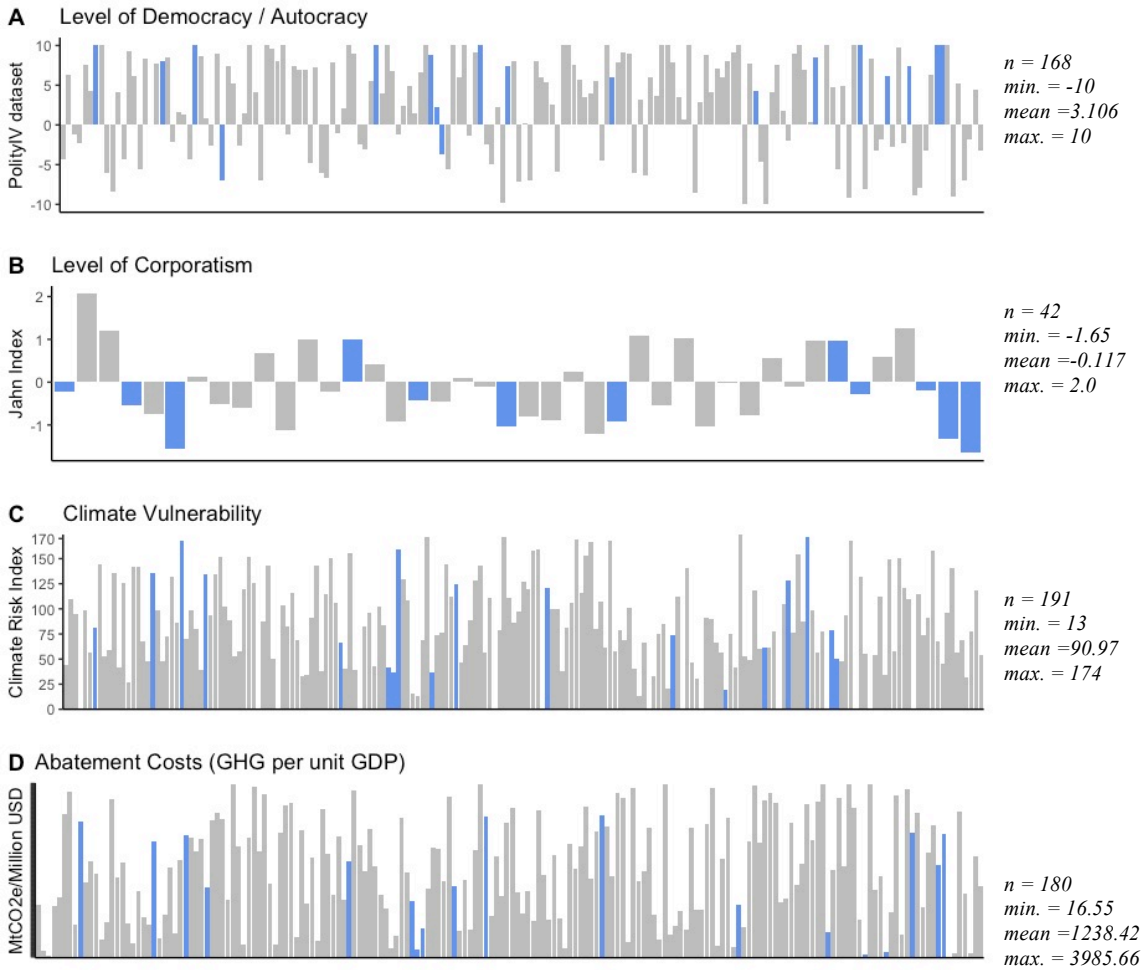


Figure 5. Bar plots of each macro-level condition.

4.2 Developing the Vertical Policy Harmonization Index (VPHI)

This section presents the construction and development of the Vertical Policy Harmonization Index (VPHI), which is the key dependent variable of interest. This index, as depicted in *Figure 6*, is an attempt at measuring the level of harmonization between international positions and commitments and national strategies, plans and policies.[8] This measurement is produced in part by assessing policy output at both levels. In their study, Schaffrin et al. (2015) describe policy output as a function of density and intensity, where density is the number of policies and intensity can be generally thought of as policy quality. More concretely, policy intensity is the amount of resources, time, and effort that are given to a specific policy instrument and is operationalized by looking at an instrument's *objective*, *scope*, *integration*, *budget*, *implementation*, and *monitoring* (Schaffrin et al. 2015). The operationalization of the intensity measures in the assessing policy output and their adaptation for the VPHI will be discussed later in this section.

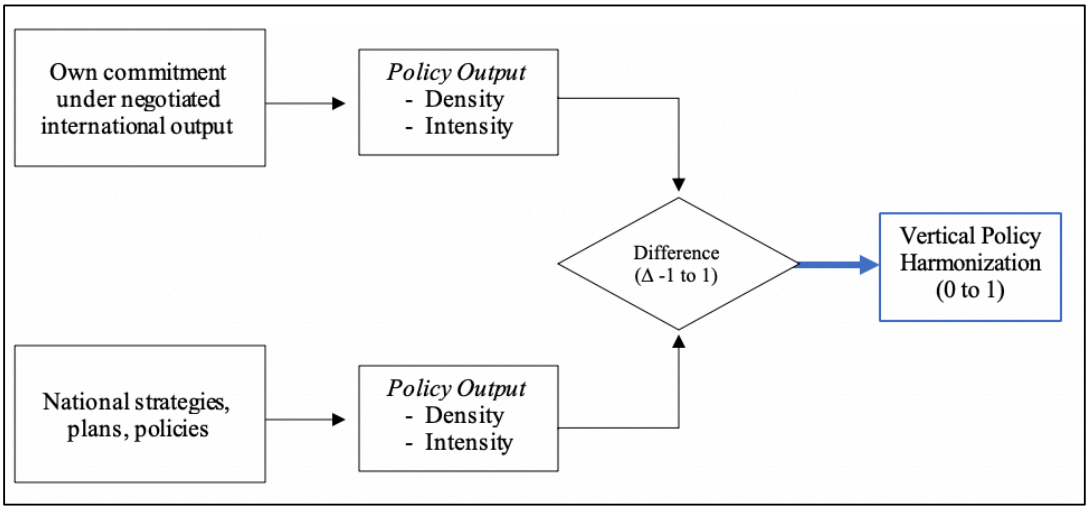


Figure 6. The Vertical Policy Harmonization Index – difference between policy output at the international and national levels is indicated in the diamond. The final VPH score is the absolute value of this difference and is indicated by the blue box on the far right of the figure. A VPH score of 0 indicates complete disharmony, while a score of 1 indicated complete harmony.

[8] For the sake of brevity, national policies while be used henceforth in reference to national strategies, plans and policies.

The VPHI focuses on policy output in the context of climate mitigation – i.e. climate adaptation measures are not taken into consideration. Adaptation policies can be highly localized in their policies, and thus focusing solely on mitigation policies concentrates the scope of the VPHI and reduces potential methodological complications (e.g. multiple adaptation policies given a country's setting in multiple climates). Moreover, adaptation to climate change concerns private goods, whereas mitigating climate change is in pursuit of a public good (Hasson & Visser 2009). That is, climate adaptation is a private endeavor that only benefits the jurisdiction (e.g. city, state, or national government) that invests in adaptation, while the benefits of mitigation are distributed, though unproportionally if free riders are present, to all those on "spaceship Earth" (Sprinz and Vaahtoranta 1994, p. 78).

At the international level, policy output includes the political commitments made to mitigating climate change as communicated in countries' (I)NDCs, while national policy output refers to the mitigation targets set forth in the policies of the national government. Despite the fact it is more accurate to describe the climate change regime being as transnational, multi-level or polycentric, as discussed in *Section 2.1*, the VPHI operates within the two-level characterization. Furthermore, the VPHI adopts the term "national" as opposed to "domestic" in describing policy output at "Level 2" (see *Figure 1*) because domestic implies the inclusion of subnational levels, which is beyond the focus of this iteration of the VPHI.

Mitigation contributions[9] communicated in (I)NDCs and national policies can vary from non-emissions related actions – e.g. renewable energy targets – to absolute or relative emissions reduction – e.g. $MtCO_2e$, or a proportion of GHGs (Taibi & Konrad 2018). Although (I)NDCs and national policies may contain one or more of these mitigation contributions, only the latter type of contribution is taken into consideration in this iteration of the VPHI for the sake of a relatively straightforward comparison process. Furthermore, only economy-wide domestic targets are used in the assessing national policy output with the reasoning that (I)NDC targets and economy-wide domestic

[9] The terms contribution and target will be used interchangeably in reference to the same concept – efforts to mitigate climate change by reducing emissions.

strategies, plans, and policies are the accumulative product of sector-specific actions. However, in cases where economy-wide targets are absent – e.g. the United States – sector-specific targets are used.

As stated before, measuring policy output involves the combined assessment of policy density and intensity. Assessing density is a straightforward task done by counting the number of mitigation contributions, whereas policy intensity requires content-based coding and scoring. To conduct the latter task, the intensity measures of Schaffrin et al. (2015) are tailored to the purpose of this index. Specifically, of the six intensity measures proposed in their study – see *Table B* in the appendix – only two (*Objective* and *Scope*) are directly taken and adapted for the VPHI. Elements of Schaffrin et al.'s *Implementation* and *Monitoring* are combined into the intensity measures *Scale* and *Status*, while *Integration* and *Budget* are not used in the VPHI given the ambiguity of (I)NDCs and some national strategies, plans and policies in these areas. *Table 3* below shows each intensity measure, their coding question, values[10] and aggregation procedure. As seen in the far-left column, the intensity measures – with the exception of *Scale* and *Status* – apply to both international and national policy output, as indicated by the subscripts '*int*' and '*nat*'. *Scale* and *Status* only apply in measuring national policy output given *Scale* assesses the national policy's target year in relation to that of the (I)NDC and it is assumed that (I)NDCs are being actively implemented – i.e. their *Status* is in force.

[10] Coding values are also referred to as scores of the given intensity measure. They are used interchangeably.

Table 3. Intensity measures, values, and aggregation

Intensity Measure	Coding Question	Coding Values	Aggregation	Range
Objective ($Obj_{int,nat}$)	What is the policy objective (w/respect to the NDC)?	0 = no specific climate target given objective for absolute or relative emissions reduction, renewable energy target or other quantified mitigation action	The value for Obj_{int} is the country's contribution as stated in their NDC. Obj_{nat} is the share of the policy's objective on the basis of that contribution.	0-1
Scope ($Scope_{int,nat}$)	[1]Does the policy target all sectors?	0 = no specific sector targeted 0.1 = for each sector targeted (Energy, Industry, Agriculture, LULUCF, Waste) 0.5 = all sectors targeted	Additive Aggregation	0-1
	[2]Are all mitigation actions targeted?	0.05 = for each action out of oil, gas, coal, wind, solar, biomass, hydro, and CHP 0.1 = energy efficiency target 0.5 = all mitigation actions targeted		
Scale ($Scale_{nat}$)	[1]Do the target years correspond?	0 = target years do not correspond 0.5 = target years correspond	Additive Aggregation	0-1
	[2]What is its basis of compliance?	0 = no enforcement mechanisms 0.5 = enforcement mechanisms present		
Status ($Status_{nat}$)	Is the policy in effect?	0 = no 1 = yes	$Status_{nat}$ is either 0 or 1, i.e. no aggregation required.	0,1

The *Objective* measure covers any targeted mitigation action mentioned in a country's (I)NDC or national policy. Mitigation actions include emissions related targets (i.e. absolute or relative emissions reduction) or non-emissions related targets (e.g. increasing electricity production from renewable sources, decreasing energy intensity); as aforementioned only emissions related targets are taken into consideration in this iteration of the VPHI. The objective score for the (I)NDC (Obj_{int}) is the targeted contribution in that country's (I)NDC, regardless of the target year. For example, the United States (U.S.) communicated a 26% to 28% reduction in GHG emissions by the year 2025; Obj_{int} for

the U.S. is 0.28.[11] The objective score for any given national policy (Obj_{nat}) is the share of that objective on the basis of Obj_{int} for that country. Additionally, if a national policy has multiple targets or target years the most ambitious is taken into consideration. For example, the United States' Clean Power Plan (CPP) targets, "emissions reductions from 2005 levels of 28% in 2025 and 32% in 2030" (*Carbon* 2015, p. 76). The objective taken into consideration is 32% in 2030; Obj_{nat} for the Clean Power Plan is 1.142.

The intensity measure *Scope* encompasses the economic sectors[12] and mitigation actions that are targeted in the (I)NDC or national policy. Two questions are asked during the content-based coding; the first question assigns 0.1 for each sector targeted in the (I)NDC or national policy (see *Tables E* and *F* in the appendix for the full list of sectors and end-uses). The second question assigns a 0 if only one mitigation action is targeted, 0.05 for each action targeted and 0.1 for energy efficiency measures[13] – see *Table 4* below for examples of mitigation actions. In the case of a general reference to promotion or expansion of renewable energies it is assumed that this includes wind, solar and hydro power, unless stated otherwise. A value for biomass measures is assigned only if it is explicitly mentioned. Generally, (I)NDCs receive a scope score of 1 as they target all sectors and specific mitigation actions are not mentioned; however, this is not always the case. The scope score is found by adding the scores of the two coding questions. For example, the United States' CPP is assigned a score of 0.45 as it targets the energy sector (0.1) with measures in renewable energy generation (0.15), improving efficiency of coal-fired electric generating units (0.05), fuel switching to lower-emitting natural gas (0.05), and increasing energy efficiency across the sector (0.1).

[11] If the targeted reduction in an (I)NDC is a range (26% to 28%), such as in this case, the most ambitious target (28%) is taken as the objective.
[12] Energy; Industry, Agriculture; Land-Use, Land-Use Change and Forestry (LULUCF); Waste
[13] Energy efficiency measures are allocated a larger value than the other mitigation actions, "due to its greater potential for greenhouse gas reductions" (Schaffrin et al 2015, p. 269).

Table 4. Example of Mitigation Actions by Sector

Sector	Activity	Action
Energy	*conservation and demand-side efficiency*	retrofit efficiency improvement in existing thermal plants and renewable energy plants; combined heat and power (CHP) generation
	generation, renewable sources	wind, photovoltaic and concentrated solar power (CSP), geothermal, biomass/gas, tidal, hydropower; training in renewable energy
	generation, non-renewable sources	existing power plants switching to lower emitting fuels (e.g. coal to natural gas)
	heating, cooling & energy distribution	integration of renewable sources into grid, energy efficiency measures in grid retrofitting
	transportation	promotion of public transportation; shift from road to rail or water transport; energy efficiency measures and fuel switching; promotion of electric mobility, hydrogen power, liquefied natural gas, hybrid engines
Industry	*general*	adoption of energy efficiency standards
	construction	promotion of energy-efficient building techniques, standards and certifications
Agriculture	*general*	farming methods to increase carbon sequestration; use of energy-saving or carbon neutral machineries and methods
	livestock	methane reduction projects
Land-use, Land-use Change and Forestry (LULUCF)	*general*	rehabilitation of areas affected by drought and deforestation
	forests	sustainable forest management; protection & enhancement of sinks and reservoirs
Waste	*sanitation systems*	energy-efficient pumps in municipal sewage systems
	management & disposal	biogas production and reuse of energy produced by wastewater facilities
	water resource	protection and/or rehabilitation of water bodies as carbon storage

Source: OECD 2016

Scale incorporates target years and the basis of compliance into the intensity measurements. This measure pertains only to national policies because it uses the (I)NDC's target year as the basis of assessment for coding question 1 and (I)NDCs typically lack detailed information on compliance. The first question addresses whether or not the target year – i.e. the year in which the objective is to be achieved – in a given national policy corresponds with the target year in the country's (I)NDC. For example, the United States' CPP is assigned a 0 given that the most ambitious objective in this national policy (32% in 2030) does not correspond with the INDC's target year of 2025. The second coding question seeks to include the national policy's basis of compliance –

i.e. whether or not the policy includes enforcement mechanisms.[14] The CPP includes text that empowers a federal agency to impose standards and also delegates enforcement to states by requiring states to provide plans to achieve the objective. As such, the CPP is assigned 0.5 for the second coding question; altogether the scale score for the CPP is 0.5.

The *Status* measure inquires about the standing of a given national policy – i.e. whether or not the text is in force. This information is found in the text or is published by the responsible domestic agency. In the case that this information is ambiguous or unavailable, it is taken from the policy summary provided by LSE's Climate Change Laws of the World or the Asia Pacific Energy Portal provided by the Asian and Pacific Energy Forum (APEF). To continue with the example of the United States, the CPP was published in August 2015 but its implementation has been stayed by the U.S. Supreme Court pending judicial review. This results in the CPP being assigned a 0 for *Status* measure. It should be noted, that this measure is given considerable weight in the overall aggregation procedure (see *Table 5* below). It is reasoned that if a national policy is not in force it is essentially null and void regardless of how well-crafted, targeted and encompassing it may be.

[14] Enforcement mechanisms can either be positive (e.g. transparent reporting and monitoring) or negative (sanctions or fines).

The final step in operationalizing policy output in the VPHI is aggregating the scores of each measure. International policy output (X_{int}) is found by adding the objective and scope scores and dividing by the number of intensity measures (2). National policy output (X_{nat}) is the sum of all national policy scores (Pol_{k}) divided by the total number of domestic policies for that country (n_{nat}). The aggregation procedures are as follows:

Table 5. Aggregation Procedure

Aggregation Procedure	**Example case (U.S.)**
$X_{int} = \frac{(Obj_{int} + Scope_{int})}{2}$	$X_{int} = \frac{0.28 + 1}{2} = 0.640$
$X_{nat} = \sum_{k=1}^{n} Pol_k / n_{nat}$	$X_{nat} = 0/1 = 0$
where,	
$Pol_{k} = \left(\frac{(Obj_{nat}/Obj_{int}) + Scope_{nat} + Scale_{nat}}{3}\right) * Status_{nat}$	$\text{Pol}_1 = \left(\frac{(0.32/0.28) + 0.45 + 0.5}{3}\right) * 0 = 0$

The final product of the VPHI is a score for vertical policy harmonization (VPH) and is founding by taking the absolute value of the difference between international policy output (X_{int}) and national policy output (X_{nat}) subtracted from 1. The absolute vale is taken so that the VPH score is fixed between 0 and 1, where 0 indicates complete disharmony and 1 complete harmony. VPH scores for each country are presented in the *Section 4.3*. For the complete list of measures of national policy output see *Table D* in the appendix; the coded statements are located in the accompanying codebook.

$$\text{VPH} = (1 - |X_{int} - X_{nat}|) \qquad \text{VPH}_{\text{U.S.}} = (1 - |0.640 - 0|) = 0.360$$

In order to assess the construction of an index and the validity of its output, an index should be compared against other indices that are measuring the same concept (Adcock & Collier 2001). Although the VPHI is an innovative attempt at measuring vertical policy harmonization in the context of climate mitigation, there are other indices – the Climate Action Tracker (CAT) and the Climate Change Performance Index (CCPI) – that measure the climate policy and performance of countries. While these indices are not measuring

the same concept as the VPHI, we can still utilize their assessment of climate policy as a yardstick. That is to say, they allow me to assess the (il)legitimacy of the policy output scores produced by the VPHI, but they do not entirely support nor refute the construction of the index or its results.

The CAT uses a "fair share" rating system to assess whether or not a country's (I)NDCs constitutes a fair contribution to emissions reductions and is consistent with the goals of the Paris Agreement. As these assessments are constrained to the international level, the CAT's ratings will be used to ascertain the validity of the VPHI's international policy output (X_{int}). Furthermore, the CAT's categorical assessments of pledges and (I)NDCs are not directly useful in validating the VPHI's measures of international policy output. To overcome this the categorizations are assigned a score from 0 to 1 (see *Table G* in the appendix for a full description of each categorization and corresponding value).

The CCPI is a composite index of countries' climate performance constructed by assessing a country's GHG emissions, renewable energy, energy use and climate policy. These four categories are comprised of 14 indicators. GHG emissions are given the most weight in the CCPI's assessment of climate performance – i.e. a country's score reflects both policy outcome and output. For the purposes of the VPHI's validation, the CCPI's international and national climate policy indicators are used. Additionally, we take the unweighted scores of each indicator and assess it against the corresponding VPHI score – i.e. X_{int} and X_{nat}. Furthermore, the difference between the CCPI's international and national climate policy scores is taken to assess the X_{Δ} scores in the VPHI.

To discern the validity of the VPHI, I compare the measures of international policy output, national policy output, the average policy output and the difference between both levels to the corresponding measures of the other indices – e.g. international output of the VPHI to that of the CCPI. First, I normalize the scores of each aspect in each index (see *Table H* in the appendix for the normalized scores) so the values of each index ranges from 0 to 1. Following this, (non-) parametric tests are performed to compare the means of the VPHI, the CCPI and the CAT. To assess the comparability of the VPHI and the

CCPI, an unpaired Student's t-test[15] is performed. This is a parametric test that requires samples to be normally distributed and have equal variances; this is checked prior to the unpaired Student's t-test and the results are shown in *Figures 8* and *9* and *Table 7*. Given that the CAT is not normally distributed (see *Figure 8*) the non-parametric Wilcoxon Rank Sum test is applied to compare the means of the VPHI and CAT measures. The results of the normality checks and (non-) parametric tests are shown in the following section.

[15] The unpaired Student's t-test is performed in R using the function *t.test()*. By default samples are tested at a confidence level of 0.95 and a significance level of 0.05. The null hypothesis is that mean of one population is equal to the mean of the other population; the alternative is set as two sided – i.e. the populations' means are not equal.

4.3 Measures of Vertical Policy Harmonization

Table 6 below shows the measures of international and domestic policy output, the difference between the two levels (X_Δ) and the measures of vertical policy harmonization (VPH) for each country. The difference between X_{int} and X_{nat} ranges from -1 to 1 with negative values indicating higher measures of policy output at the national level as compared to the international level. This may be an indication of more ambitious climate mitigation measures at the national level, but such an interpretation should be cautioned with the assumptions and methodological approach of the VPHI; this will be further discussed in *Section 7.1*. The measures for X_Δ (A) and VPH (B) are graphically displayed in *Figure 7*.

Table 6. Measures of Vertical Policy Harmonization

	X_{int}	X_{nat}	X_Δ	VPH
KOR	0.635	0.626	0.009	0.991
TUR	0.605	0.578	0.027	0.973
INS	0.645	0.602	0.043	0.957
RUS	0.650	0.767	-0.117	0.883
UKG	0.700	0.833	-0.133	0.867
IRN	0.520	0.383	0.137	0.863
DEU	0.700	0.896	-0.196	0.804
CHE	0.750	0.517	0.233	0.767
BRA	0.685	0.450	0.235	0.765
SAF	0.630	0.367	0.263	0.737
CAN	0.650	0.967	-0.317	0.683
AUS	0.640	0.317	0.323	0.677
THI	0.550	0.200	0.350	0.650
CHN	0.825	0.453	0.372	0.628
MEX	0.610	1.149	-0.539	0.461
IND	0.675	0.050	0.625	0.375
USA	0.640	0.000	0.640	0.360
JPN	0.630	1.376	-0.746	0.254

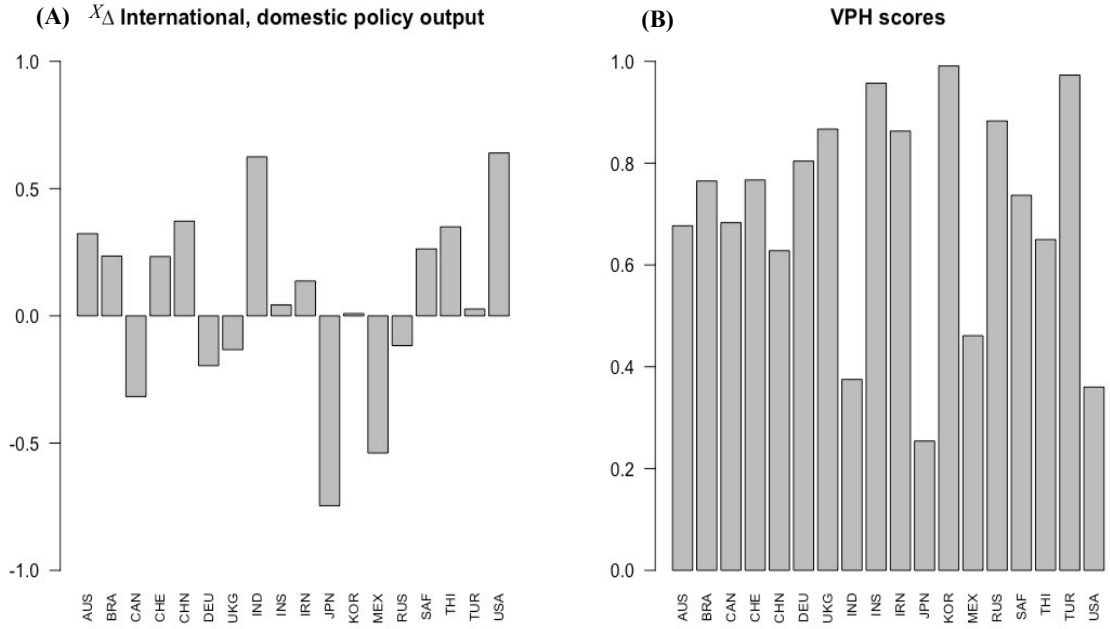


Figure 7. Results from the VPHI. (A) the difference between international and national policy output from -1 to 1. (B) measures of vertical policy harmonization from 0 to 1.

Across the 18 cases, the average level of VPH is 0.7053 with the highest level exhibited by South Korea (KOR) at 0.991 and the lowest level by Japan (JPN) at 0.254. This is reflected in *Figure 8* with Japan having the largest X_Δ and South Korea the smallest. It can also be seen, that six countries are characterized as having higher levels of policy output at the national level as opposed to the international level. However, interpretating this as more ambitious climate action at the national level than the international level should be cautioned given the reciprocity of vertical policy harmonization and the methodological approach of the VPHI. At first glance, it is surprising to see that some countries, such as Russia (RU) and Iran (IRN) exhibit higher levels of vertical policy harmonization, than others such as Germany (DEU) or Canada (CAN). Perhaps, Germany and Canada exhibit lower levels because there is more "climate activity" at both levels, making vertical harmonization more difficult.[16] On the other hand, Russia and Iran appear

[16] Here, I refer to the propensity to pursue climate policies, or the engagement in climate action; in other words, climate policy output. While I do not cite any evidence, I conject that Germany and Canada are characterized by more "climate conscious" cultures than Russia or Iran.

to be less engaged in climate action. While at this point this is purely conjecture, and certainly warrants further investigation, Germany and Canada do exhibit higher levels of international and national policy output than both Russia and Iran. What may seem like an unexpected result to the reader is Japan's place as the least harmonized country. However, this is not entirely surprising given the methodological approach of the VPHI, in that the most ambitious action is considered when multiple targets exist. This approach led to Japan being attributed such a high score for national policy output; the implications of the VPHI's methodological approach are further discussed in *Section 7.1*.

Convergent Validation

The distribution of each index's normalized score for international policy output is shown in *Figure 8* below. In order to assess the validity of the VPHI, parametric tests are performed to compare the means of the different indices. To compare means via parametric tests, a population's distribution must be normal and they must share equal variances. By plotting the normalized scores of each index, it can be inferred that the VPHI and the CCPI are normally distributed, whereas the CAT is not. To reinforce this visual inference, a Shapiro-Wilk normality test is conducted to establish the normality of a distribution; this is conducted in R.[17] With p-values greater than the significance level of 0.05 the VPHI (0.2715) and CCPI (0.2056) can be assumed to be normally distributed; we cannot assume the CAT is normally distributed given its p-value (0.02707) is less than the significance level. Given the non-normal distribution of the CAT, the Wilcoxon Rank Sum test[18] will be applied to compare the means of the normalized X_{int} scores for the VPHI and the CAT. This non-parametric test is performed in order to test the validity of the VPHI and does not require the distributions to be normal.

[17] The Shapiro-Wilk normality test is performed in R using the *shapiro.test()* function; this test the multivariate normality of the given population (Royston 1982).
[18] The Wilcoxon Rank Sum test is performed using the *wilcox.test()* function in (David & Bauer 1972; Hollander & Wolfe 1973).

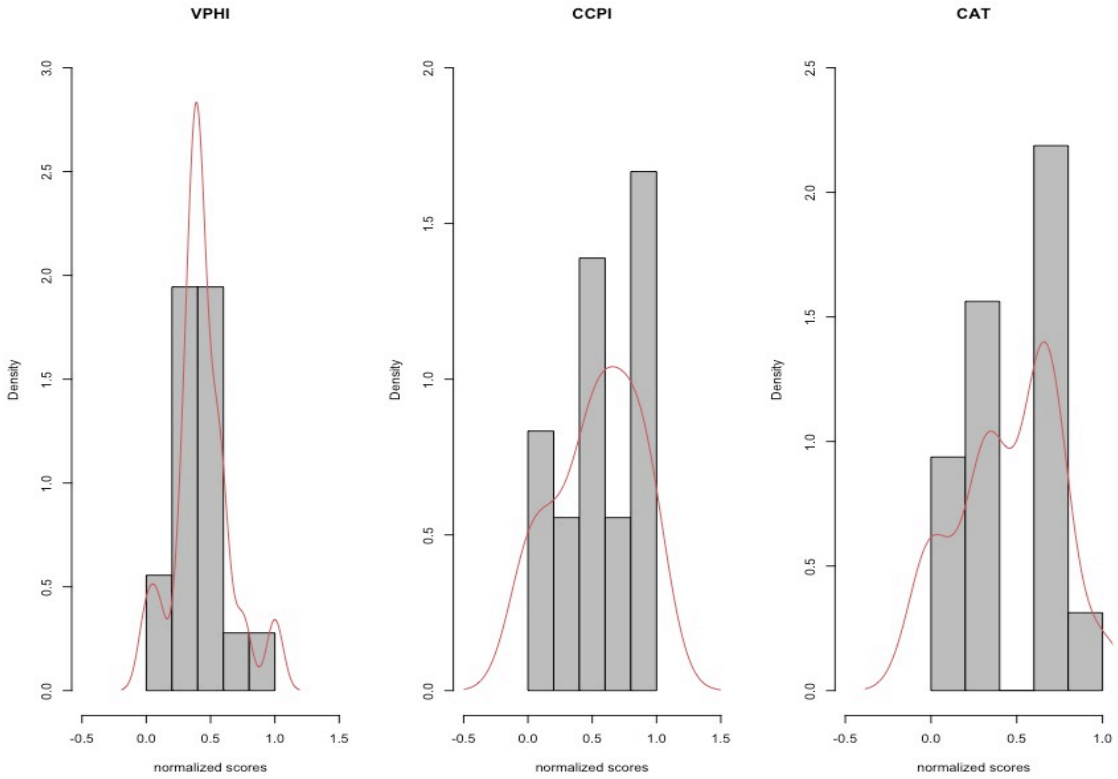


Figure 8. Distribution of normalized international policy output (X_{int})

Figure 9 shows the distributions for domestic policy output (A), average policy output (B) and the difference between international and national policy output (C) for the VPHI and CCPI indices. Each measure of the VPHI and CCPI appear to be normally distributed; this inference holds given the p-values of each measure are greater than the significance level 0.05 – i.e. the measures are assumed to be normally distributed. Finally, to compare the variances of the VPHI and CCPI distributions a two-sided F-test is performed; its results are shown in *Table 7*. The F-test is conducted with a confidence level of 0.95 at a significance level of 0.05. With p-values of each measure being greater than the significance level, it is concluded that there is no significant difference in the variances of the VPHI and the CCPI.

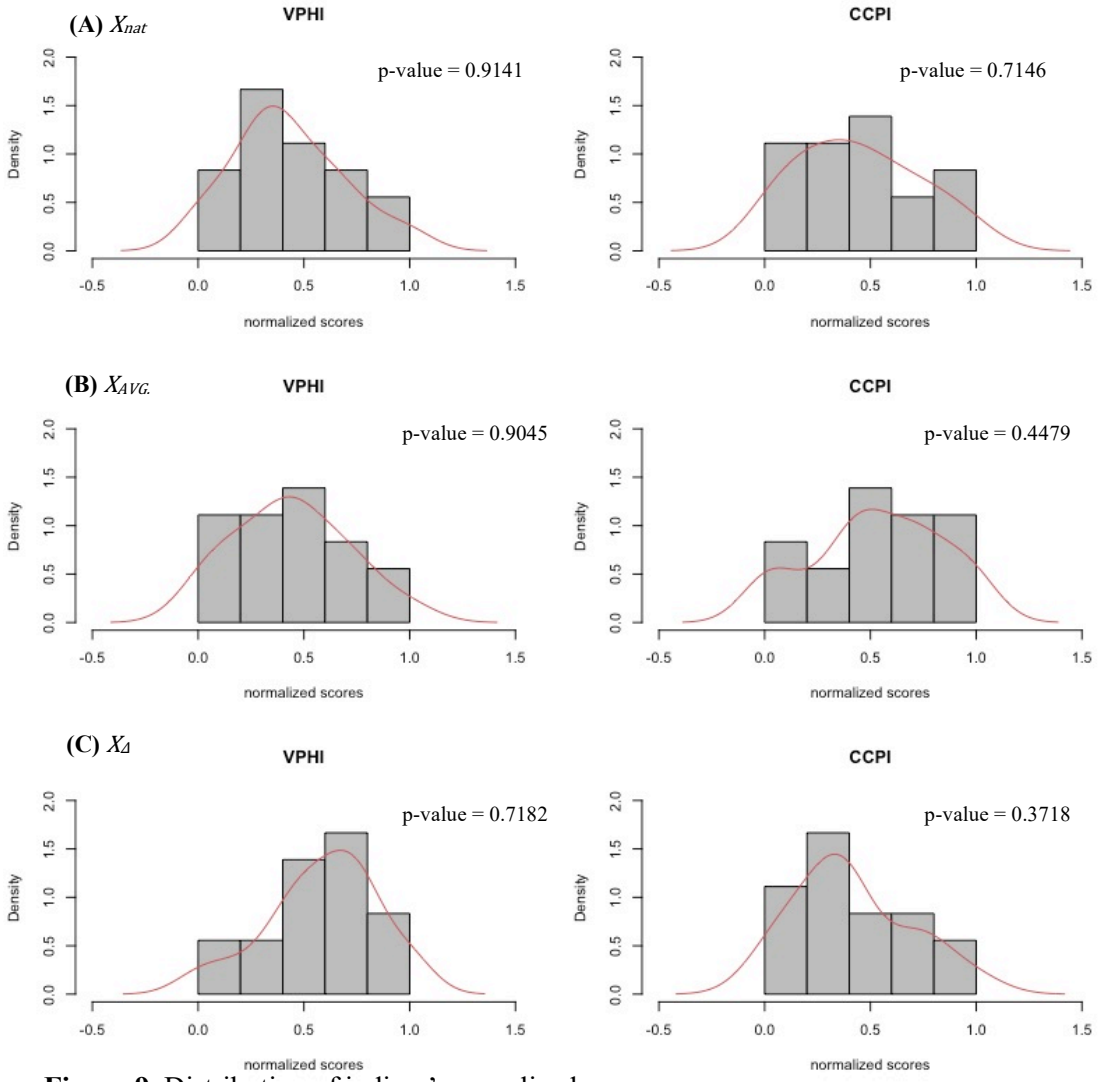


Figure 9. Distribution of indices' normalized scores

Table 7. P-values of F-test

	X_{int}	X_{nat}	$X_{AVG.}$	X_{Δ}
p-value	0.1201	0.6821	0.602	0.8587

Now that the (non-) normality for the indices' measures is established, the Wilcoxon Rank Sum test and unpaired Student's t-test are conducted. The Wilcoxon Rank Sum test is a non-parametric test that can be used to compare the means of populations, regardless of their normality. The Student's t-test also compares the means of populations but requires the populations to be normally distributed and have equal variances. Since the

CAT is not normally distributed (see *Figure 8*) the Wilcoxon Rank Sum test is used to compare the means of international policy output (X_{int}) in the VPHI and the CAT. To compare the CCPI and the VPHI, the Student's t-test is conducted, given the normality and equal variances of these indices – see *Figure 9* and *Table 7*.

Table 8. R Output of (non-)parametric tests

<table>
<tr><th colspan="2">Wilcoxon Rank Sum test</th></tr>
<tr><td colspan="2">X_{int}</td></tr>
<tr><td colspan="2">Wilcoxon rank sum test with continuity correction

data: vphi.ndc and cat.ndc
W = 137, p-value = 0.8213
alternative hypothesis: true location shift is not equal to 0
95 percent confidence interval:
-0.2568443 0.0983417
sample estimates:
difference in location
-0.04860849</td></tr>
<tr><th colspan="2">Student's t-test</th></tr>
<tr><td>X_{int}</td><td>X_{nat}</td></tr>
<tr><td>Welch Two Sample t-test

data: vphi.ndc and ccpi.ndc
t = -1.1079, df = 29.927, p-value = 0.2767
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-0.29575664 0.08774129
sample estimates:
mean of x mean of y
0.4335155 0.5375232</td><td>Welch Two Sample t-test

data: vphi.dom and ccpi.dom
t = -0.18608, df = 33.66, p-value = 0.8535
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-0.2066760 0.1720152
sample estimates:
mean of x mean of y
0.4251857 0.4425161</td></tr>
<tr><td>$X_{AVG.}$</td><td>X_{Δ}</td></tr>
<tr><td>Welch Two Sample t-test

data: vphi.avg and ccpi.avg
t = -0.97451, df = 33.453, p-value = 0.3368
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-0.2938787 0.1034593
sample estimates:
mean of x mean of y
0.4372051 0.5324148</td><td>Welch Two Sample t-test

data: vph.diff and ccpi.diff
t = 1.9291, df = 33.935, p-value = 0.06211
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-0.009343196 0.358510334
sample estimates:
mean of x mean of y
0.5867003 0.4121168</td></tr>
</table>

The p-values in the Wilcoxon Rank Sum test – see *Table 8* – assert that there is no significant difference between the means of X_{int} in the VPHI and the CAT – that is, these indices are not producing significantly different measures of international policy output. With the p-values in the Student's t-test, we can conclude that the VPHI and the CCPI have not produced significantly different measures of X_{int}, X_{nat}, X_{AVG}. and X_{Δ}. The results from these tests show that the construction and measures of the VPHI are more or less valid in comparison to the CAT and the CCPI. The validity of the VPHI and its methodological differences in relation to the reference indices are discussed further in *Section 7.1*.

Narrowing the focus of assessment to individual cases, *Table 9* shows the difference of the normalized scores for each country. That is, the values shown are the absolute difference between the CAT or CCPI's normalized score and the VPHI's normalized score for a given measure. For example, in international policy output (X_{int}) Australia (AUS) has a normalized score of 0.393 in the VPHI and 0.667 in the CAT, the absolute difference is approximately 0.273 – see *Table H* in the appendix for all the normalized scores of each country across each index. The cases and values in bold are those that have relatively large differences between the indices; in total there are 7 cases that exhibit relatively large differences. It should be noted, that the assertions of large difference are not grounded in a statistical test but is rather an inference made in relation to the other values listed in the table.

Of the measures, the difference between international and national policy output (X_{Δ}) has the highest number of cases with a relatively large difference. However, if we focus our attention on international and national policy output (X_{int} and X_{nat}), as they form the basis of measures of vertical policy harmonization, we see that only five cases exhibit relatively large differences. Despite these differences, the results per country across the indices do not seem unexpected or worrisome besides that of China and India; these cases exhibit large differences in almost every measure. A potential source of difference could be the CAT and CCPI took different policies into consideration when producing an assessment of national climate policies. Along these same lines, it is expected that a majority of the differences between the indices' measure of international and national policy output

originate from their methodological approaches; this is discussed further in *Section 7.1*. Nevertheless, it is encouraging to see that a majority of the cases (11) have relatively small differences between their normalized measures across the indices.

Table 9. Difference of Indices' normalized scores by cases

	X_{int}		X_{nat}	$X_{AVG.}$	X_{Δ}
	Δ VPHI, CAT	Δ VPHI, CCPI	ΔVPHI, CCPI	ΔVPHI, CCPI	ΔVPHI, CCPI
AUS	0.2732241	0.3934426	0.2303779	0.2313324	0.3605992
BRA	0.1256831	0.3273733	0.0974876	0.0020922	**0.6009412**
CAN	0.2404372	**0.5059676**	0.2687916	0.0085156	**0.5118464**
CHE	0.0874317	0.0422297	0.2185431	0.2517832	0.3038351
CHN	**0.6666667**	0.1949490	**0.6707849**	**0.5329429**	**0.8066378**
DEU	0.0765028	0.4098361	0.0898566	0.1332124	0.3371784
UKG	0.0765028	0.3589528	0.2531146	0.3319625	0.1234867
IND	0.4918033	0.3054385	**0.8032602**	**0.8448771**	**0.7841492**
INS	0.0765028	0.2003904	0.1450375	0.0347157	0.1000005
IRN	na	**0.5084598**	0.4386420	0.4896468	**0.5903221**
JPN	0.0273224	0.1063636	**0.7735675**	**0.7378162**	0.3904463
KOR	0.0437159	0.1738341	0.1990939	0.2107880	0.3780454
MEX	0.3715847	0.1795386	0.4576415	0.3578517	0.2789335
RUS	0.4262295	0.1500332	0.3357040	0.1490814	0.2677348
SAF	0.0273224	0.4625590	0.0686252	0.2665905	0.2720058
THI	na	0.3253766	0.2886212	0.3902934	0.4831595
TUR	0.2786885	0.2504477	0.3445806	0.3374328	0.2108942
USA	0.3934426	0.3934426	0.0565825	0.0340531	**0.6585795**

To summarize this section, I construct the Vertical Policy Harmonization Index by finding the absolute difference between international and national policy output. Policy output was operationalized by counting the number of policies and evaluating intensity using the adapted intensity measures of Schaffrin et al. (2015). Following this, I establish the validity of the VPHI by comparing the normalized means of each index's measures of international policy output, domestic policy output, average policy output and the difference of policy output. In *Section 7.1*, the extent to which these assessments validate or refute the VPHI's construction will be discussed in addition to the methodological limitations of the index.

5. Method: Qualitative Comparative Analysis

In the second part of this thesis, I address the research question laid out in *Section 1* using Qualitative Comparative Analysis (QCA). With this method, I study how the different conditions determine the occurrence of the set outcome. The outcome of interest – otherwise referred to as the key dependent variable – are the measures of vertical policy harmonization, as presented and validated in the previous section.

Developed for applications in comparative politics and historical sociology, Qualitative Comparative Analysis (QCA) takes the advantages of qualitative and quantitative techniques and brings them together in a macro-comparative approach that allows researchers to systematically compare cases without sacrificing complexity (Berg-Schlosser et al. 2012). That is, QCA combines the techniques of case-oriented and variable-oriented approaches in analyzing set relations between explanatory (conditions) and dependent (outcome) variables in cases by studying the different combination of casual conditions that lead to the expected outcome. This refers to QCA's tenet of equifinality in which, "many roads can lead to Rome: the same phenomenon can have different, mutually non-exclusive explanations" (Thomann & Maggetti 2017, p. 2). That is, the set outcome can result from different combinations of conditions (Ragin 2008).

The QCA method is rooted in set theory, in which two analytical approaches are used to assess the commonality of conditions or outcomes across cases; see *Figure 10*. Ragin (2008) notes that the first approach (A) finds, "casual conditions shared by cases with the same outcome" (p. 19) whereas the second (B) assesses whether or not cases with the same conditions experience the same outcome. The first strategy is appropriate for assessing the necessity of conditions, whereas the second strategy is used in evaluating sufficiency. These are the terms in which the set relations between conditions and an outcome are defined. Necessary conditions are those that are required for the outcome to occur, whereas conditions deemed to be sufficient are present whenever the outcome occurs (Schneider 2018). Thomann and Maggetti (2017) illustrate these set relations as follows: condition X is *necessary* for outcome Y, if whenever X is present Y occurs, whereas condition X is *sufficient* if the occurrence of outcome Y implies the presence of condition X. To be less abstract, let us take the set relation between democracy and high

levels of environmental performance. Democracy would be considered a *necessary* condition for high levels of environmental performance, if whenever a democratic system of governance is present, so are high levels of environmental performance. Democracy would be said to be *sufficient* if high levels of environmental performance implies the presence of a democratic system of governance.

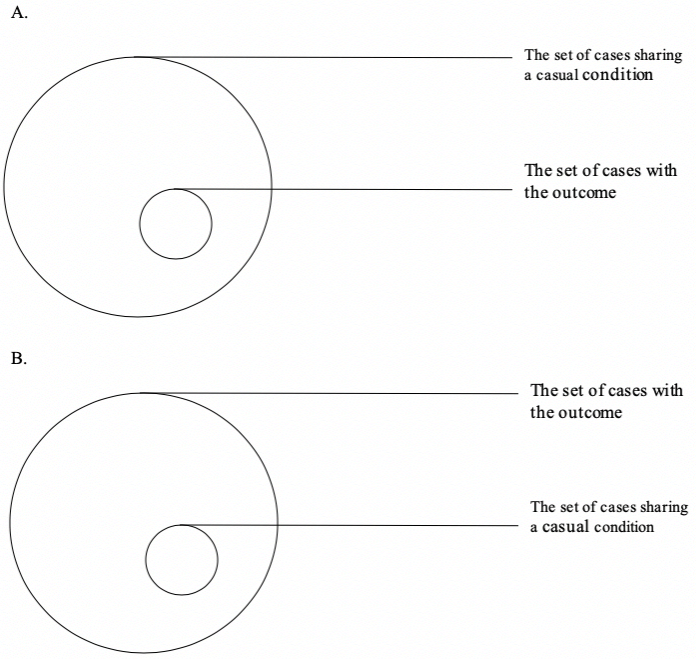


Figure 10. Two different kinds of case-oriented research (Ragin 2008, p. 19).

Thomann and Maggetti (2017) cite several reasons why the QCA method is useful in public policy analysis. Among these is the ability of QCA to provide more insight by studying the interplay of variables than would be provided by examining single variables and determining them as the explanations for the outcome. That is, QCA allows for "conjectural causation" across cases while leaving space for complexity (Berg-Schlosser et al. 2012, p. 7). Furthermore, QCA is chosen as it is geared toward small- or intermediate-N designs at the macro-level (Berg-Schlosser et al. 2012).

Since its epistemological foundations were established in the 18th and 19th centuries QCA has been significantly refined and developed into four main variations – crisp-set (csQCA), fuzzy-set (fsQCA), multi-value (mvQCA), and two-step fsQCA (Sehring et al. 2013). Each variant is in the direction of providing a more nuanced determination of membership – i.e. whether or not a case belongs to a given set, such as being democratic. The first version, csQCA, took a binary approach to allocating cases membership to certain conditions (Sehring et al. 2013) – e.g. a country was either democratic (1) or autocratic (0), with no variation allowed in between. Following csQCA, was the introduction of fuzzy sets which allowed for a more gradual assessment of set membership (Ragin 2009). For example, a country could be more democratic than not (0.7) or more autocratic than not (0.2) with a cross-over point (0.5) indicating maximum ambiguity between being "out" or "in" a set (Ragin 2009). Finally, mvQCA was introduced as a middle ground between csQCA and fsQCA by allowing the membership of some conditions to be dichotomous (1 or 0, yes or no) and others gradual (Sehring et al. 2013). Of these, fsQCA is to be applied in this study. The general steps in (fs)QCA are the selection and operationalization of conditions and outcomes, determining (non-)membership values, calibrating the raw data and analyzing the sufficiency and/or necessity of conditions in relation the outcome (Thomann & Maggetti 2017;)

In fsQCA, the membership values can be set in three-, four-, six- or continuous values (Ragin 2009; Thomann & Maggetti 2017). That is, each version sets different thresholds for partial or full (non-) membership; continuous value fsQCA is implemented in this thesis. Moreover, the membership thresholds can be anchored using qualitative or quantitative criteria – e.g. case knowledge or statistical indicators; I use the latter this thesis. As such, the threshold for full membership is the maximum value, full non-membership the minimum value, and the cross-over point is the median value of the raw dataset. Given the unit of analysis is at the macro-level, values were taken from the complete dataset (i.e. 160+ countries)[19], as opposed to just the selected cases. This avoids any chance of misrepresenting a country's membership in a condition. For example, if we were to set the membership thresholds for vulnerability based on just the cases, a

[19] The dataset on Corporatism, from Jahn (2014), is comprised of the mean scores of 42 countries.

country might qualify as highly vulnerable relative to the other cases, when in reality it is not. *Table 10* below lists each condition and their thresholds as anchored in the raw datasets.

Table 10. Membership values in continuous fuzzy set

Condition	Membership value	Anchor (raw data values)
Democracy		Indicator: PolityIV score
Strongly democratic (DEM)	fully in = 1	10
	more in than out = $0.5 < X_i < 1$	
	neither in nor out (cross-over) = 0.5	0
	more out than in = $0 < X_i < 0.5$	
Strongly autocratic (~DEM)	fully out = 0	-10
Corporatism		Indicator: Jahn (2014) Index
Strong corporatism (CORP)	fully in = 1	2.06
	more in than out = $0.5 < X_i < 1$	
	neither in nor out (cross-over) = 0.5	-0.225
	more out than in = $0 < X_i < 0.5$	
Strong pluralism (~CORP)	fully out = 0	-1.65
Vulnerability		Indicator: CRI score
Highly vulnerable (VUL)	fully in = 1	13
	more in than out = $0.5 < X_i < 1$	
	neither in nor out (cross-over) = 0.5	86.83
	more out than in = $0 < X_i < 0.5$	
Not vulnerable (~VUL)	fully out = 0	174
Abatement costs		Indicator: GHG per unit GDP (USD)
High abatement costs (ABT)	fully in = 1	3985.66
	more in than out = $0.5 < X_i < 1$	
	neither in nor out (cross-over) = 0.5	960.95
	more out than in = $0 < X_i < 0.5$	
Low abatement costs (~ABT)	fully out = 0	16.55

The fuzzy set scores for each condition are determined using the direct calibration function in the fs/QCA 2.5 software. Direct calibration is the process for determining the orientation for membership by setting the cross-over point (neither in nor out), the upper bound (fully in) and lower bound (fully out). Following this, the direct calibration function in fs/QCA 2.5 uses a logistic function to fit the raw data within these thresholds. The bounds, or thresholds, used in this thesis are anchored on the median, maximum and minimum values of each condition from their raw dataset, see *Table 10*.[20] The fuzzy set scores for measures of vertical policy harmonization (VPH), democracy (DEM), corporatism (CORP), vulnerability (VUL) and abatement costs (ABT) of are shown in *Table 11* below. Negation (~) indicates the absence of the condition and reverses the

[20] For the condition abatement costs ($MtCO_2e$ per Million $USD) outliers were removed so as not to skew or misrepresent the membership thresholds.

orientation of membership – e.g. full membership in ~VUL is not vulnerable and full non-membership is highly vulnerable. The negated scored is found by, ~V = 1 – VUL. In this way, every possible combination of conditions can be set; the number of possible combinations is 2^k with k being the number of conditions.

Given the definition of corporatism used in this thesis (*see footnote 6*), and the lack of corporatism scores for some countries, a subset is taken to test the second hypothesis. As such, there are 16 possible combinations in addressing the second hypothesis. In testing the first and third hypotheses, there are 8 possible combinations as the corporatism condition is excluded. Concisely put, the whole sample is used in evaluating H_1 and H_3, whereas a restricted sample is used in H_2.

Table 11. Fuzzy set scores

	DEM		CORP		VUL		ABT		VPH	
	Raw value	*Fuzzy set*	*Raw value*	*Fuzzy set score*	*Raw value*	*Fuzzy set score*	*Raw value*	*Fuzzy set score*	*Raw value*	*Fuzzy set score*
AUS	10	0.95	-0.22	0.5	52.83	0.8	631.2	0.26	0.677	0.39
BRA	8	0.92	-0.55	0.34	86	0.51	454.5	0.17	0.765	0.54
CAN	10	0.95	-1.55	0.06	94.17	0.44	492.8	0.18	0.683	0.40
CHN	-7	0.11	*na*	–	53.33	0.8	2235.9	0.78	0.628	0.32
DEU	10	0.95	1.01	0.83	42.83	0.86	316.4	0.11	0.804	0.66
IND	8.8	0.93	-0.43	0.39	36.5	0.89	1994.1	0.74	0.375	0.09
INS	2.32	0.67	*na*	–	74.17	0.63	1069.1	0.53	0.957	0.93
IRN	-3.72	0.25	*na*	–	76	0.61	1482.8	0.63	0.863	0.80
JPN	10	0.95	-1.03	0.16	88.17	0.49	234.4	0.09	0.254	0.05
KOR	7.36	0.9	-0.27	0.48	79	0.58	676.5	0.29	0.991	0.95
MEX	6	0.86	-0.91	0.19	61.33	0.74	682.6	0.29	0.461	0.15
RUS	4.35	0.79	*na*	–	49	0.82	1898.9	0.72	0.883	0.84
SAF	8.52	0.93	0.96	0.83	78.5	0.58	1363.0	0.6	0.737	0.48
CHE	10	0.95	-0.2	0.51	54.83	0.79	104.7	0.06	0.737	0.55
THI	6.08	0.86	*na*	–	34.83	0.89	1060.8	0.52	0.650	0.35
TUR	7.48	0.9	*na*	–	110	0.31	522.7	0.2	0.973	0.94
UKG	10	0.95	-1.33	0.09	68	0.68	310.1	0.11	0.867	0.81
USA	10	0.95	-1.65	0.05	45.17	0.84	513.7	0.19	0.360	0.09

After setting the fuzzy scores of all possible combinations, the combinations observed with at least one case will be tested for sufficiency and necessity. Although the hypotheses only posit a set relation of sufficiency between the given condition(s) and the level of vertical policy harmonization, both sufficiency and necessity will be assessed. Evaluating the empirical support for the posited connection between conditions and the outcome is done by looking at the parameters of consistency and coverage. Consistency assesses the degree to which cases with the same combination of conditions share the same outcome, whereas coverage details the extent to which the combination of conditions can account for the outcome given equifinality – i.e. many different paths can result in the same outcome (Ragin 2008). In other words, consistency indicates whether or not the connection between the combination of conditions and the outcome warrant more attention, and coverage points to the empirical relevance of the connection (Ragin 2008).

The truth table enables the researchers to assess the sufficiency of the logical combinations of (negated) conditions by varying them one at a time (Ragin 2008). Boolean algebra is applied in the truth table to indicate the different types of configurations – i.e. * means *AND* while + indicates *OR*. The fuzzy set score in *AND* configurations is the minimum fuzzy set score across the (negated) conditions, while in *OR* configurations it is the maximum score. For example, in the DEM*CORP*VUL*ABT configuration Australia receives a 0.26 as it is the lowest fuzzy set score across that combination; this is read as strong democratic characteristics *AND* evidence of strong corporatism *AND* high vulnerability *AND* high abatement costs. If the *OR* operation is used (DEM+CORP+VUL+ABT) Australia receives a 0.95; this configuration reads as strong democratic characteristics *OR* evidence of strong corporatism *OR* high vulnerability *OR* high abatement costs. See *Tables I* and *J* in the appendix for all the possible logical combinations of conditions, including their negations.

Not all logical combinations have cases in which the configuration of conditions are empirically observed, and these are deemed counterfactual cases and their rows in the truth table logical remainders (Ragin & Sonnett 2008); these are not analyzed for sufficiency. In this thesis, sufficiency is determined against the standard consistency

measure of 0.8 (Schneider & Wagemann 2012); if a row in the truth table (see *Tables 13 and 15*) meets or exceeds this threshold that configuration is deemed to be sufficient. Following the determination of sufficiency, the process of logical minimization can be applied in order to eliminate redundant terms and provide the most parsimonious path (Thomann & Maggetti 2017). For example, DEM*CORP*VUL*ABT + DEM*CORP*VUL*~ABT can be minimized to DEM*CORP*VUL. The complex paths for sufficiency are presented in *Tables 14 and 16*, and the intermediate and parsimonious solutions are shown in *Tables K* and *L* in the appendix.

In assessing necessity, the fs/QCA 2.5 software outputs both the measures of coverage and consistency as well as the parameter of relevance of necessity (RoN). The threshold for establishing the necessity follows that of Kunz et al. (2015), although it is advised to set the threshold given the study's context (Schneider & Wagemann 2012). Nevertheless, a (combination of) condition(s) is deemed necessary if the consistency measure is greater than or equal to 0.8 and the RoN is greater than or equal to 0.5. The following section present the results of fsQCA using the aforementioned program by Ragin and Davey (2014). This program was used to calibrate the raw values into fuzzy set scores, analyze sufficiency using the truth table algorithm, and provide the different solutions that result in the occurrence of the outcome. Preceding the analysis, the fuzzy set scores output from fs/QCA 2.5 were input manually in truth tables showing every logically possible combination of conditions; see *Tables I* and *J*. Additionally, the fuzzy set scores were input into the QCA package in R (Dusa 2019) to produces the measures of necessity and sufficiency. Finally, the hypotheses are addressed by extending the conventional tools of testing sufficiency in fsQCA to the individual condition of autocratic characteristics (H_1) and combination of conditions of democratic characteristics and corporatism (H_2) and high vulnerability and low abatement costs (H_3).

6. Results

This section briefly discusses the expectations of vertical policy harmonization and reflects on the implications of the produced measures. Additionally, the analyses of set relations between the macro-level conditions and the outcome show the sufficient paths and necessary conditions for higher and lower levels of vertical policy harmonization. Finally, the hypotheses are addressed by extending the conventional tools of fsQCA to the arguments laid out in *Section 3*.

6.1 Expectations of Vertical Policy Harmonization

As briefly discussed in *Section 4.3*, it was surprising to see some countries receive higher scores of VPH than others, but overall the measures of international and national policy output produced by the VPHI were comparable to that of the CAT and the CCPI. That being said, it seems that the levels of vertical policy harmonization, on average, seems higher that what was anticipated. It was expected that many, if not all, countries would struggle to some degree in aligning their international commitments and national policies, but an average VPH score of 0.7053 suggests otherwise. This could be the result of the mathematical construction of the VPHI – see *Table 3* – or the methodological approach of assessing international and national policy output. Here, I make a distinction between the implementation of the policy output scores in the VPHI (the mathematical construction) and the coding of the scores themselves (the methodological approach). The former seems to be the likely source for unexpectedly higher levels of vertical policy harmonization, given the methodological approach in scoring policy output produced similar results to that of the other indices at both the international and national levels. Perhaps the mathematical construct of the index was too straightforward in subtracting the absolute difference between the two levels from one, or the lack OF weighted intensity measures resulted in a too abstract assessment of policy output. This is discussed further in *Section 7.1*.

From a practical point of view, the measures could indicate that having higher levels of climate activity – i.e. policy output – at both levels makes harmonization more difficult. However, this only an intuitive, if not conjectural interpretation of the VPH measures. In

this iteration of the VPHI, measures of national policy output do not directly reflect the entirety of climate policies at this level. While the '*n*' at the international level is constant, given countries have communicated one (I)NDC thus far,[21] the number of national climate policies varies by country and is further limited in scope as only economy-wide mitigation policies are captured – see *Section 4.2*. Again, this is further discussed in *Section 7.1*

6.2 fsQCA

This section presents the results of the application of fsQCA and the analyses of sufficiency and necessity. It should be reiterated the analyses and the testing of the hypotheses are subset – i.e. the conditions and hypotheses of democracy, vulnerability and abatement costs are evaluated across all 18 cases, whereas 12 cases are subset to test all four conditions given six cases are not attributed with measures of corporatism. The following subsections present the conventional analysis of necessary and sufficient conditions in affecting the occurrence of the set outcome – i.e. higher or lower levels of vertical policy harmonization. This is followed by an extension of the fsQCA tools to directly address the hypotheses and judge whether or not these findings refute or support them. Furthermore, as this is an imperfect application of the fsQCA process, the results presented here should be taken as rough estimates of how the conditions facilitate or inhibit vertical policy harmonization; this will be discussed further in *Section 7.2*.

6.2.1 Necessary Conditions

Table 12 shows the results from testing the necessity of conditions, and their combinations, on effecting a positive or negative outcome – i.e. higher or lower levels of vertical policy harmonization. With the predefined thresholds of necessity at the consistency ≥ 0.8 and RoN ≥ 0.5 (see *Section 5*) it is determined that high vulnerability is a necessary condition and the configuration of autocracy *AND* high vulnerability *AND* high abatement costs (~DEM*VUL*ABT) are necessary conditions for the positive outcome to occur. That is, the characterization of being of being highly vulnerable is

[21] This will change in future iterations of the VPHI, with countries updating their (I)NDCs with new targets. It is not certain how these updates will be incorporated into the VPHI, but the update will certainly provide a more dynamic measurement of international policy output.

likely necessary for higher levels of vertical policy harmonization, as well as the combination of being a highly vulnerable autocratic country facing high abatement costs. This characterization also holds in the occurrence of the negative outcome, for both high vulnerability and the ~DEM*VUL*ABT configuration. Additionally, pluralism and low abatement costs are said to be necessary conditions for lower levels of vertical policy harmonization.

Table 12. Analysis of Necessary Conditions

Set outcome:	*higher levels of VPH (positive outcome)*			*lower levels of VPH (negative outcome)*		
	Consistency	Coverage	Relevance of necessity	Consistency	Coverage	Relevance of necessity
DEM	0.876	0.554	0.329	0.934	0.548	0.326
CORP	0.649	0.756	0.875	0.459	0.709	0.854
VUL	**0.821**	**0.626**	**0.556**	**0.905**	0.639	**0.565**
ABT	0.513	0.740	0.873	0.515	0.689	0.852
~DEM	0.285	0.824	0.963	0.239	0.641	0.927
~CORP	0.750	0.511	0.545	**0.842**	**0.761**	**0.710**
~VUL	0.527	0.857	0.937	0.470	0.709	0.880
~ABT	0.470	0.709	0.880	**0.806**	**0.605**	**0.587**
DEM*VUL*~ABT	0.940	0.553	0.230	1.00	0.545	0.227
DEM*VUL*ABT	0.942	0.553	0.228	1.00	0.545	0.225
DEM*~VUL*~ABT	0.903	0.561	0.311	0.947	0.546	0.304
~DEM*VUL*ABT	**0.836**	**0.624**	**0.539**	**0.905**	**0.627**	**0.540**
DEM*~CORP*VUL*~ABT	0.990	0.457	0.118	1.00	0.611	0.157
DEM*CORP*VUL*~ABT	0.990	0.457	0.118	1.00	0.611	0.157
DEM*~CORP*~VUL*~ABT	0.990	0.457	0.118	1.00	0.611	0.157
DEM*CORP*VUL*ABT	0.990	0.457	0.118	1.00	0.611	0.157
DEM*~CORP*VUL*ABT	0.990	0.457	0.118	1.00	0.611	0.157

The upper third of *Table 12* shows the results for each individual condition and their negation. It can be seen that democracy does not qualify as a necessary condition, either in its presence or absence, in effectuating either a positive or negative outcome. Although democracy exhibits a strong consistency value in both set outcomes – i.e. 87% and 93% respectively – its relevance of necessity is quite low, thus not qualifying as a necessary condition. On the other hand, the results show that corporatism, vulnerability and abatement costs can be categorized as necessary conditions. The absence of corporatism (~CORP) and high abatement costs (~ABT) demonstrate necessity in the occurrence of the negative outcome, while vulnerability (VUL) is a necessary condition for both the positive and negative outcome. In layman's terms, the attribution of pluralist systems of interest representation and high abatement costs, individually, are likely necessary conditions for lower levels of vertical policy harmonization. High vulnerability is a necessary condition for both higher and lower levels of vertical policy harmonization. The results of necessity and sufficiency for each individual condition are graphically displayed in XY plots in *Figure A* in the appendix.

6.2.2 Sufficient Conditions

In this analysis, sufficiency was determined against the backdrop of just the positive set outcome – i.e. it was not determined which conditions, or their combinations, are sufficient for the occurrence of lower levels of vertical policy harmonization; this is discussed in *Section 7.2*. The truth tables below show the analysis of sufficient conditions. *Table 13* uses the whole sample – i.e. all 18 cases with the configurations of democracy, vulnerability and abatement costs. As can be seen, only four configurations of conditions have empirically observed cases and the rest are logical remainders. Of these four, only two are regarded as sufficient paths for higher levels of vertical policy harmonization with consistency values larger than 0.8.

Table 13. Truth Table for Analysis of Sufficient Conditions

Row	DEM	VUL	ABT	# of cases	Consistency	Cases
1	1	1	0	8	0.689	AUS, BRA, DEU, KOR, MEX, CHE, UKG, USA
2	1	1	1	5	0.778	IND, INS, RUS, SAF, THI
3	1	0	0	3	0.850	CAN, JPN, TUR
4	0	1	1	2	0.845	CHN, IRN
5	0	0	0	0	-	-
6	0	1	0	0	-	-
7	0	0	1	0	-	-
8	1	0	1	0	-	-

The truth tables are read with the Boolean operator *AND* (*), as such the sufficient paths in *Table 13* are DEM*~VUL~ABT (Row 3) and ~DEM*VUL*ABT (Row 4). There are cases of logical contradiction in both configurations as the membership score of a case in that configuration is larger than the outcome and falls on the opposite side of the cross over point (Schneider & Wagemann 2012). In the Row 3 configuration, both Canada (0.56; CAN) and Japan (0.51; JPN) are logical contradictions with their respective outcome score of 0.40 and 0.05; see *Table I* in the appendix. In the Row 4 configuration, China (CHN) is a logical contradiction with a membership score (0.78) larger than its outcome (0.32). Verbalized, the cases of Canada and Japan contradict the assertion that the configuration of democracy *AND* low vulnerability *AND* low abatement costs is a sufficient path for higher levels of vertical policy harmonization. Similarly, China's case contradicts the assertion that autocratic characteristics *AND* high vulnerability *AND* high abatement costs is a sufficient path for higher levels of vertical policy harmonization.

Setting higher levels of vertical policy harmonization as a function of democracy, vulnerability and abatement costs, the Quine-McCluskey algorithm (Ragin and Davey 2014) returned the raw coverage, unique coverage, and consistency values for the paths

as shown in *Table 14*.[22] The raw coverage indicates how much the outcome is accounted for by a single path, and the unique coverage signals how much that specific path leads to the occurrence of the outcome (Schenider & Wagemann 2012). The terms solution coverage and consistency respectively show, "the proportion of memberships in the outcome that is explained by the complete solution" (Ragin 2017, p. 61) and the extent to which the set of solution terms is a subset of the outcome. With these in mind, the presence of democratic characteristics *AND* the absence of high vulnerability *AND* high abatement costs constitutes a sufficient path for higher levels of vertical policy harmonization; however, the inverse – i.e. the presence of autocratic characteristics and the presence of high vulnerability and abatement costs – is also considered a sufficient path for the outcome. Of these, the first combination of sufficient conditions is the most relevant as it accounts for 29% of the occurrence of higher levels of vertical policy harmonization.

Table 14. Sufficient Paths for Higher Levels of Vertical Policy Harmonization

	Raw Coverage	Unique Coverage	Consistency
DEM*~VUL*~ABT	0.5	0.297645	0.850638
cases covered	*CAN, JPN, TUR*		
~DEM*VUL*ABT	0.269807	0.0674518	0.845638
cases covered	*CHN, IRN*		
solution coverage	0.567452		
solution consistency	0.805471		

As mentioned before, including the condition of corporatism restricts the number of cases and increases the number of logically possible combinations, see *Table 15*. Of the 16 logically possible combinations only five configurations are empirically observed. Furthermore, only one of these is considered a sufficient path (Row 2) leading to the outcome given its consistency value exceeds the predefined threshold. Within this configuration, the case of Germany (DEU) is a logical contradiction with a membership score (0.83) larger than the outcome (0.66) – i.e. although the parameters indicate that

[22] The program returns complex, intermediate and parsimonious solutions; the complex solution is presented in *Tables 14 & 16,* and the intermediate and parsimonious solutions in *Tables K* and *L* in the appendix.

this configuration is a subset of the outcome, this set relation does not hold in the case of Germany. That is, the combination of democratic characteristics *AND* corporatism *AND* high vulnerability *AND* low abatement costs is sufficient for higher levels of vertical policy harmonization in Switzerland but not in Germany.

Table 15. Truth Table for Analysis of Sufficient Conditions (including corporatism)

Row	DEM	CORP	VUL	ABT	# of cases	Consistency	Cases
1	1	0	1	0	5	0.645217	BRA, KOR, MEX, UKG, USA
2	1	1	1	0	2	0.844961	DEU, CHE
3	1	0	0	0	2	0.769014	CAN, JPN
4	1	1	1	1	1	0.794872	SAF
5	1	0	1	1	1	0.683794	IND
6	0	0	0	0	0	-	-
7	0	1	0	0	0	-	-
8	1	1	0	0	0	-	-
9	0	0	1	0	0	-	-
10	0	1	1	0	0	-	-
11	0	0	0	1	0	-	-
12	1	0	0	1	0	-	-
13	0	1	0	1	0	-	-
14	1	1	0	1	0	-	-
15	0	0	1	1	0	-	-
16	0	1	1	1	0	-	-

Setting the occurrence of the outcome as a function of democracy, corporatism, vulnerability and abatement costs, the algorithm returned a solution consistency of 0.844961 for the combination of conditions listed in *Table 16*. With a raw and unique coverage of 0.633721 the combination of sufficient conditions accounts for 63% of the occurrence of the outcome. Articulated, the presence of democracy *AND* corporatism *AND* high vulnerability *AND* the absence of high abatement costs is a sufficient path for the outcome to occur. Again, this assertion holds for Switzerland but not for Germany.

Table 16. Sufficient Paths for Higher Levels of Vertical Policy Harmonization (including corporatism)

	Raw Coverage	Unique Coverage	Consistency
DEM*CORP*VUL*~ABT	0.633721	0.633721	0.844961
cases covered	*DEU, CHE*		
solution coverage	0.633721		
solution consistency	0.844961		

6.2.3 Addressing the Hypotheses

The above analyses examine the casual combination of the conditions on effectuating the outcome, but they do not directly address all of the hypotheses laid out in *Section 3*. Specifically, the first hypothesis is addressed within the conventional analysis of fsQCA, whereas the second and third are not. That being said, the analysis of sufficiency is extended to the combination of democracy and corporatism (DEM*CORP) in addition to high vulnerability and low abatement costs (VUL*~ABT).

The first hypothesis postulates a sufficient relation between the presence of autocratic characteristics (~DEM) and higher levels of vertical policy harmonization. Assessing this claim is done by looking at the consistency value of ~DEM (see *Table 12*) against the standard consistency measure. With a consistency measure of 0.285, the presence of autocratic characteristics does not qualify as sufficient condition leading to higher levels of vertical policy harmonization. That is, there is no empirical support for the first hypothesis, as the consistency score indicates that only 28.5% of cases that are characterized as being autocratic exhibit the same outcome. Outside the purview of the above conventional analyses is the sufficient relation of democracy *AND* corporatism

(DEM*CORP) and vulnerability *AND* low abatement costs (VUL*~ABT), which comprise the second and third hypotheses respectively. Using the same QCA package in R (Dusa 2019) the consistency values for these two set relations are calculated. With a consistency value of 0.990, DEM*CORP is a sufficient combination for the outcome to occur – i.e. being democratic and having a corporatist system of interest representation is a combination sufficient for higher levels of vertical policy harmonization. Moreover, the consistency value signals that 99% of countries with this same combination of conditions share the same outcome. Turning to the last hypothesis, the combination VUL*~ABT is found to be sufficient for the outcome to occur with a consistency value of 0.905. Specifically, the combination of high vulnerability and low abatement costs is a combination sufficient for higher levels of vertical policy harmonization, with 90% of cases attributed with this combination of conditions having the same outcome.

Given the conventional analysis of the fsQCA method and its extension to individual conditions, the first hypothesis is rejected whereas there is evidence to support the second and third hypotheses. Although the presence of autocratic characteristics is included in a sufficient path leading to the outcome (see *Table 14*), alone it does not qualify as being sufficient for higher levels of vertical policy harmonization. All in all, the analyses above demonstrate that the relationship between the macro-level conditions and vertical policy harmonization is intricate. That is, despite there being a link between some of the conditions and vertical policy harmonization, the results should not be extrapolated onto other cases – e.g. finding that democracy and corporatism is a sufficient combination of conditions for higher levels of vertical policy harmonization in Switzerland and Germany does not imply that all countries with high levels of vertical policy harmonization are democratic or have corporatist systems of interest representation, and vice versa. The findings of the fsQCA method in this thesis are rough estimates of the influence of the selected conditions on vertical policy harmonization, especially given the fact that four cases are logical contradictions of the supposedly sufficient paths. Furthermore, the scope of conditions included in the analysis should be widen given the diversity at the macro-level and the complex interplay of international and national levels. The limitations of applying the fsQCA method to analyze conditions that inhibit or enhance vertical policy harmonization are discussed further in the next section.

7. Discussion

This section presents a discussion of the VPHI and the application of fsQCA in addressing the research question. Though partially validated, the construction of the VPHI and the decisions made in its development warrant further discussion – namely the methodological differences between the VPHI and the reference indices, the limitations of the VPHI's approach and points to be refined in future iterations of the index. The application of fsQCA is imperfect and limited within the context of this thesis.

7.1 Limitations of the VPHI

In constructing the VPHI, countries' (I)NDCs and national strategies, plans and policies were taken into consideration in evaluating international and national policy output. Content-based coding was applied to these texts and scores for policy output were found at both levels by counting the number of policies and quantifying policy intensity by utilizing the approach of Schaffrin et al. (2015). The absolute difference between the international and national policy output was subtracted from one to fit the final VPH score between a scale of 0 (complete disharmony) and 1 (complete harmony). Following this, the VPHI's scores for international policy output (X_{int}), national policy output (X_{nat}), average policy output (X_{AVG}) and their difference (X_{Δ}) were normalized for comparison against the corresponding aspects of the CAT and the CCPI. In validating the construction and results of the VPHI, the Student's t-test and the Wilcoxon Rank Sum test were performed to assess the difference between the means of each aspect of the reference indices and the VPHI. These tests found no significant difference between the different aspects of the VPHI and the other indices, partially validating the VPHI. This was further supported by the observation that a majority of countries exhibited relatively small differences in their normalized scores across the indices. That being said, these results do not fully support nor refute the VPHI's construction or measures of policy output, given discrepancies in the reference indices' methodological approaches and the sample size of the validation procedure.

The CCPI and the CAT do not adopt the same approach as the VPHI, let alone measure the same concept. That is to say, the different indices measure different things differently.

Conceptually, the VPHI incorporates policy output within its measurement of vertical policy harmonization, whereas the CCPI and the CAT touch on both policy output and outcome in their respective assessments of climate policy performance. In its construction, the CAT adopts a similar approach to the VPHI – i.e. using quantitative data and methods to produce its assessment. Here, the CCPI differs by deriving its scores of international and domestic climate policy from experts' survey responses.[23] This enables the CCPI to increase the number of countries and policies it covers in its assessment; the VPHI is limited to (I)NDCs and economy-wide domestic policies that are available in English. Although the use of surveys increases the coverage and depth of the CCPI's data, it opens the door for misrepresentation. Reflecting on this aspect of the CCPI's construction, Bernauer and Böhmelt (2013) state, "[expert assessments] are sometimes hard to replicate, unreliable, and either case less transparent than those directly observable factors" (p. 199). That is, survey responses may be subjective assessments – hopefully rooted in rational, objective judgement – that are not impervious to bias or change. In fact, a study by Ingold et al. (2019) found a discrepancy between Swiss actors' policy positions as stated in official consultation texts and their survey responses. Regardless of what causes these discrepancies (e.g. position correction, when the data was gathered) these studies highlight the fact that survey-derived data is harder to replicate and less transparent than data taken from publicly available documents and can lead to different assessments of the same concept.

As shown in *Section 4.3*, the Student's t-test and the Wilcoxon Rank Sum test was conducted to assert some degree of validity to the VPHI and its measures. Although the assumptions of being normally distributed and having equal variances were established, ambiguity persists as to whether or not this was an appropriate test to apply given the sample size. In this aspect, the discourse has revolved around the general rule of thumb that parametric tests only be applied to samples with a population size no less than 30; with the conditions of normality and equal variances no less than 15 (Weaver 2015). Furthermore, it is generally recommended that non-parametric tests are applied to small

[23]Experts respond to questionnaires asking them to evaluate the strength and level of implementation of climate mitigation measures in their respective countries. At the international level, experts assess their country's performance at international conference.

sample sizes, but such tests fail to provide significant results regardless of the data (Martin Bland 2009). To summarize, although the Student's t-test and the Wilcoxon Rank Sum test produced significant results, indicating that the VPHI produces relatively accurate measurements of international and national policy output, it should be cautioned to interpret this as wholly conclusive evidence of the VPHI's validity.

In any given study there is a constant give-and-take between complexity and parsimony. This is certainly heightened in the development of an index that is novel and measures a multi-faceted concept. In the course of the VPHI's construction decisions were made in favor of parsimony rather than complexity. As that is the case, the current shortcomings of the VPHI are aspects to be refined in future iterations; they are laid out below by each measure of policy intensity (see *Section 4.2*).

> *Objective*: To recall, this intensity measure looks at the target explicitly mentioned in the (I)NDC or domestic policy. In next iterations of the VPHI, it is suggested that the index should take into consideration national policies that include moving targets (e.g. increasing ambition over multiple target years), contingent targets (e.g. increased ambition with international assistance), or targets that express mitigation reductions in units other than those that correspond to the country's (I)NDC. The last target type will undoubtedly be a cumbersome mathematical task, but could be automated in statistical programs such as R. The last suggestion for this intensity measure relates to the fact that the score for national policies is found on the basis of the international objective score. As it stands, the initial point of comparing the international and national level is already in determining national policy output. This feature will be removed in the next iteration of the VPHI and will relegate the first point of comparison in taking the difference between the two levels.
>
> *Scope*: This measure asks which economic sectors are targeted and which mitigation actions are prescribed. It is suggested that mitigation actions are weighted in relation to the economic profile of a given country. Take for example, the Islamic Republic of Iran. In this case, improving energy efficiency, increasing

the penetration of Carbon Capture and Storage (CCS) technologies and promoting the use of natural gas are significant mitigation actions for such a carbon intense country whose economy is dependent on the production, consumption and exportation of oil. Similarly, it is suggested that mitigation actions should be linked to the targeted sectors. An economy-wide domestic policy could contain a multitude of mitigation actions across the whole policy but only assign certain actions to certain sectors; in this iteration of the VPHI an economy-wide domestic policy is accredited to have all mentioned mitigation actions apply to all economic sectors when in reality particular actions may be tailored to a particular sector. Additionally, the number of mitigation actions should be increased to include actions such as the promotion of CCS technology, participation in emissions trading systems (ETSs), carbon tax or other financial mechanisms and nuclear power. Finally, the promotion of renewable energy is given considerable weight in this version of the VPHI. If a domestic policy generally refers to renewable energy it is assigned points for wind, solar, and hydropower; however, if only one form of renewable energy is explicitly mentioned without the others than it is assigned a point only for that form of renewable energy. As it stands, ambiguity is rewarded over specificity.

Scale: This measure looks at the target years and the presence of compliance mechanisms in domestic policies. The first suggestion in this measure is linked to the objective measure – i.e. to consider multiple target years. In this iteration of the VPHI, only the ultimate target and corresponding target year of a given national policy is taken into consideration. This produces output scores that indicate highly ambitious national mitigation actions, for example see Japan and Mexico in *Table 6*. While it is not being argued that this is a misrepresentation of reality, even though it could be, it could be a potential source of discrepancy the VPHI and other indices. This could present some challenges in validating this index, and frankly already has. The second suggestion is to refine the incorporation of enforcement mechanisms in this intensity measure. As it stands, positive (e.g. transparency, monitoring, assistance) and negative (e.g. sanctions, fines) enforcement mechanisms are treated equally – i.e. the presence of

enforcement mechanisms is equally awarded regardless of orientation. Whether or not different types of enforcement mechanisms increase levels of compliance has been the subject of numerous studies. Drawing on two of these studies – Fenn and Veljanovski (1988) and Stafford (2012) – the type of enforcement mechanisms that is most effective depends on policy's setting and actors targeted for compliance.[24] While this is a relatively minute detail within the context of this index and study, differentiating between the two types of enforcement can add complexity and nuance to the analysis of a national policy.

Status: The task of assigning the status score is straightforward but being sure of the information taken into consideration is another matter. In this iteration, the status was determined given the publication date of the text or the "Timeline of Events" infographic on the national policy's profile in the Climate Change Laws of the World database by the London School of Economics. Most of the information presented on these pages simply state if the national policy has been passed, amended, or in the odd cases if its implementation has been stayed. While, this does not address the coding question in the most direct manner, the method for determining status seemed appropriate in the first version of the index. It is suggested that this measure be refined by consulting other sources to find more detailed information on policies' status. Furthermore, a more gradual assessment of status is suggested. For example, if a national climate policy is being considered before a legislative body but has yet to be passed or implemented it could receive a lower status score while still acknowledging the possibility of future implementation. As the national strategy, plan or policy transitions from a draft to a text-in-force, its status score will be updated.

[24] Fenn and Veljanovski (1988) found that tactics other than formal sanctions – a negative mechanism – such as bargaining can be a more cost-effective approach to promoting compliance; though the cost-effectiveness varies from firm to firm. In the same way, Stafford (2012) found that compliance assistance (e.g. technical assistance, knowledge building, regulatory flexibility) increased compliance among small hazardous waste generators, while it had no significant effect on the compliance of larger facilities.

The next steps in developing the VPHI include reevaluating its mathematical foundation, aggregation procedures and intensity measures, as well as including Bernauer and Böhmelt's Climate Change Cooperation Index (C3-I) in the next validation procedure. The C3-I was not included in this round of convergent validation due to time constraints. In regard to the VPHI's construction and aggregation procedures, a more robust mathematical procedure could help reduce measurement error and better insulate the validity of the VPHI from missing or ambiguous data. A potential source for future consultation in improving this aspect of the VPHI is the Handbook on Constructing Composite Indicators published by the Organisation for Economic Co-operation and Development (OECD). Turning to the intensity measures, the application of *Scale* and *Status* should be extended to international policies in order to reduce error, because as it stands only *Objective* and *Scope* determine the score for international policy output. This should be done in addition to the suggestions listed above. Finally, it is suggested that the content-coding and scoring procedures should be reviewed and conducted by an additional coder. In this way, inter-coder reliability practices could be implemented to reduce an individual coder's discretion, and subsequent ambiguity, in scoring policy intensity. That is, the presence of multiple coders facilitates a discussion on whether or not the assigned intensity scores are accurate and appropriate.

These suggestions are made in order to increase the validity of the next versions of the VPHI, and more importantly increase the practical relevance of the index's results for other researchers and policymakers. Despite the fact that this version of the VPHI has its fair share of shortcomings, it has been an exercise that has provided insight on the complexity of quantitative policy analysis, measuring policy output and constructing an index to measure vertical policy harmonization. The suggestions laid out above will be integrated in future iterations of the VPHI, namely in my doctorate studies in tandem with a Swiss Network for International Studies (SNIS) project that more widely studies policy and politics in the multi-level climate change regime.

7.2 fsQCA

In applying the fsQCA method, the conditions were selected, and the orientation of membership scores and outcome were set – e.g. full membership in the vulnerability condition is high vulnerability, as opposed to low vulnerability. Following this, the raw values from datasets of democracy, corporatism, climate vulnerability and abatement costs were calibrated into fuzzy set scores setting the maximum raw value as the upper bound, the minimum raw value as the lower bound and the median raw value as the cross-over point. Then, the truth table algorithm in fs/QCA 2.5 and the QCA package in R were used to test necessity and calculate sufficient paths for higher or lower levels of vertical policy harmonization. Finally, the fsQCA method was extended to address the hypotheses, limiting the analysis to single conditions (first hypothesis) or paired conditions (second and third hypotheses).

Though insightful, the findings of fsQCA are not conclusive given the method itself and how it was applied in this thesis. First, the (fs)QCA is an avenue for systematic comparison and evaluation of connections between conditions and outcomes but preserves the complexity and nuance of individual cases at the same time. This implies that the findings presented in *Section 6.2* are limited to those specific cases, and do not implicate other cases in exhibiting the same outcomes. Moreover, these findings are rough estimates given the limits and construction of the VPHI discussed above, especially given the fact membership of some cases contradicted the paths found to be sufficient – see *Section 6.2.2*. Second, the selection of cases in this thesis render significant comparison with (fs)QCA difficult. Berg-Schlosser and De Meur (2012) state that cases must share some common attribute(s) that can be held as a constant(s) throughout the analysis. That is, the researcher should delineate cases with complete homogeneity or maximal heterogeneity to utilize the Most Similar, Different Outcome (MSDO) or Most Different, Similar Outcome (MDSO) strategies (Berg-Schlosser & De Meur 2012). On one hand, unit homogeneity enables a researcher to see what factors may explain different outcomes if all the cases are similar – MSDO. On the other, with maximal heterogeneity a researcher can establish factors that lead to the same outcome across different cases – MDSO. As the selection of cases in this thesis falls somewhere between being

homogeneous and heterogenous, the most similar or most different strategies, that facilitate significant comparison in (fs)QCA, were not used to their utmost potential.

Finally, the (fs)QCA method was imperfectly applied in addressing the hypotheses. First and foremost, the hypotheses themselves were not constructed in the most QCA-conducive fashion by focusing on single conditions or a couple conditions leading to the occurrence of the outcome. Furthermore, the analyses of sufficiency did not present conditions effectuating a negative outcome – i.e. lower levels of vertical policy harmonization – and were restricted to *AND* configurations of conditions. The findings only assert which conditions are sufficient, either in present or absent form, with higher levels of vertical policy harmonization and do not evaluate which conditions are present or absent with lower levels. That is, only one aspect – facilitating factors – of the research question was addressed.

Despite the shortcomings of the current application of the (fs)QCA method, it is promising to see evidence of an empirical link between macro-level conditions and vertical policy harmonization. The analyses provided insight into how the selected macro-level conditions and their combinations influence levels of vertical policy harmonization. That being said, it is suggested that future analyses using the (fs)QCA method should include *OR* configurations, negative outcomes and widen the scope of conditions considered. The first two considerations will provide more insight on how the combinations of democracy, corporatism, vulnerability and abatement costs influence vertical policy harmonization. The last suggestion acknowledges that these are not the only factors at the macro-level that can enhance or inhibit vertical policy harmonization. As such, it is suggested that future research should investigate how different institutional characteristics – e.g. majoritarian vs. consensus or presidential vs. parliamentarian – effect levels of vertical policy harmonization. Given the proximity of such macro-level characteristics to international and domestic and policy-making processes, it is anticipated that such analyses will provide more practical insight than the conditions analyzed in this thesis in aligning international commitments and national strategies, plans or policies.

8. Conclusion

Despite the shortcomings of the fsQCA method in this thesis and the limitations of the VPHI, an empirical link between macro-level conditions and vertical policy harmonization was established. Using fuzzy set Qualitative Comparative Analysis, it was found that autocratic characteristics, alone, are not a sufficient explanation for higher levels of vertical policy harmonization, refuting the argument made in the first hypothesis. However, there was empirical support for the second and third hypotheses, suggesting that democratic characteristics in combination with a corporatist system of interest representation (H_2) and high vulnerability in combination with low abatement costs (H_3) are sufficient conditions for motivating countries to align their international positions and national strategies, plans or policies. Furthermore, in the conventional procedure of fsQCA, it was concluded that vulnerability is a necessary condition for higher levels of vertical policy harmonization as well as the combination of autocratic characteristics, high vulnerability and high abatement costs (see *Table 12*). This latter combination was also found to be a sufficient path for higher levels of vertical policy harmonization, in addition to democratic characteristics in combination with low vulnerability and low abatement costs (see *Table 14*). These results indicate that some of the macro-level conditions increase the likelihood of countries in aligning their international positions with national strategies, plans or policies. However, as mentioned in the previous section, the analysis of sufficiency did not consider a debilitating relationship between the conditions and outcome, and as such no interpretations of which macro-level conditions are sufficient for lower levels of vertical policy harmonization are made. Another shortcoming of this application of fsQCA was the lack of complete homogeneity or maximal heterogeneity across cases. These will be addressed in future research, in addition to the inclusion of additional macro-level conditions.

In the process of convergent validation, the Student's t-test and Wilcoxon Rank Sum test were conducted on different aspects of the VPHI, the CAT and the CCPI. The results from these tests partially validate the construction and measures of the VPHI. Measures of vertical policy harmonization were found by taking the difference between international and national policy output. As a function of density and intensity, policy

output was found by averaging a policy's *Objective*, *Scope*, *Scale* and *Status* scores across the number of policies (see *Table 5*). In constructing the index, decisions were made that decreased the index's complexity in favor of parsimony. This resulted in the index being somewhat limited in its depiction of international and national policy output. Nevertheless, this iteration of the VPHI is a productive contribution in the two-level game literature and in measuring the gap between international positions and national policies.

In combination, the application of fsQCA and the development of the VPHI shed light on some reasons that inhibit or enhance countries' ability in translating international policies into domestic action and integrating domestic interesting into international policymaking processes. As one of the problems that has plagued the global, multi-level effort to tackle climate change, it is hoped that this index and its future iterations will provide practical information to scholar and policymakers alike by drawing the curtains back on what motivates countries at both the international and domestic levels. That being said, much work is left to be done in order to fulfill the potential of the VPHI and make it a relevant contribution in the two-level game and climate policy literature.

9. References

Adcock, R., & Collier, D. (2001). Measurement Validity: A Shared Standard for Qualitative and Quantitative Research. American Political Science Review, 95(3), 529–546. https://doi.org/10.1017/S0003055401003100

Albrecht, J., & Arts, B. (2005). Climate policy convergence in Europe: An assessment based on National Communications to the UNFCCC. *Journal of European Public Policy*, *12*(5), 885–902. https://doi.org/10.1080/13501760500161571

Avery W.P. (1998). Domestic Interests in NAFTA Bargaining. *Political Science Quarterly 113* (2), 281–305.

Asian and Pacific Energy Forum – APEF (2013). Asia Pacific Energy Portal [Dataset}

Bache I, Flinders M. 2004. Multi-level Governance. University Press: Oxford.

Bailer, S., & Weiler, F. (2015). A political economy of positions in climate change negotiations: Economic, structural, domestic, and strategic explanations. *The Review of International Organizations*, *10*(1), 43–66. https://doi.org/10.1007/s11558-014-9198-0

Bättig, M. B., & Bernauer, T. (2009). National Institutions and Global Public Goods: Are Democracies More Cooperative in Climate Change Policy? *International Organization*, *63*(2), 281–308. https://doi.org/10.1017/S0020818309090092

Baumert, K. A., Herzog, T., & Pershing, J. (2005). *Navigating the numbers: Greenhouse gas data and international climate policy*. World Resources Institute.

Bennett, C. J. (1991). What Is Policy Convergence and What Causes It? *British Journal of Political Science*, *21*(2), 215–233. https://doi.org/10.1017/S0007123400006116

Berg-Schlosser, D., & De Meur, G. (2012). Comparative Research Design: Case and Variable Selection. In B. Rihoux & C. Ragin (Eds.), *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques*. SAGE Publications, Inc. https://doi.org/10.4135/9781452226569

Berg-Schlosser, D., De Meur, G., Rihoux, B., & Ragin, C. (2012). Qualitative Comparative Analysis (QCA) as an Approach. In B. Rihoux & C. Ragin (Eds.), *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques*. SAGE Publications, Inc. https://doi.org/10.4135/9781452226569

Berg-Schlosser, D., & Quenter, S. (2020). *Macro-Quantitative vs Macro-Qualitative Methods in Political Science—Advantages and Disadvantages of Comparative Procedures using the Welfare-State Theory as an Example*. 24.

Bernauer, T., & Böhmelt, T. (2013). National climate policies in international comparison: The Climate Change Cooperation Index. *Environmental Science & Policy*, *25*, 196–206. https://doi.org/10.1016/j.envsci.2012.09.007

Betsill, M. M., & Bulkeley, H. (2004). Transnational Networks and Global Environmental Governance: The Cities for Climate Protection Program. *International Studies Quarterly*, *48*(2), 471–493. https://doi.org/10.1111/j.0020-8833.2004.00310.x

Bodansky, D., & Rajamani, L. (2018). The Evolution and Governance Architecture of the United Nations Climate Change Regime. In U. Luterbacher & D. Sprinz (Eds.), *Global Climate Policy: Actors, Concepts, and Enduring Challenges*.

Bulkeley, H., & Bestill M. M. (2003). Cities and Climate Change: Urban Sustainability and Global Environmental Governance. London: Routledge.

Burck, J., Marten, F., Bals, C., Hagen, U., Frisch, C., Höhne, N., & Nascimento, L. (2018). *Climate Change Performance Index: Background and Methodology*.

Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units; Final Rule (80). (2015). Environmental Protection Agency; Federal Register.

Carley, S., & Miller, C. J. (2012). Regulatory Stringency and Policy Drivers: A Reassessment of Renewable Portfolio Standards: Regulatory Stringency and Policy Drivers. *Policy Studies Journal*, *40*(4), 730–756. https://doi.org/10.1111/j.1541-0072.2012.00471.x

Castro, P., Hörnlein, L., & Michaelowa, K. (2014). Constructed peer groups and path dependence in international organizations: The case of the international climate change negotiations. Global Environmental Change, 25, 109–120. https://doi.org/10.1016/j.gloenvcha.2014.01.007

Climate Action Tracker (2020) *Methodology*. https://climateactiontracker.org/methodology/

Crepaz, M. (1992). Corporatism in Decline? An Empirical Analysis of the Impact of Corporatism on Macroeconomic Performance and Industrial Disputes in 18 Industrialized Democracies. *Comparative Political Studies*, *25*(2), 139–168.

Crepaz, M. (1995). Explaining national variations of air pollution levels: political institutions and their impact on environmental policymaking. *Environmental Politics* 4, 391-414.

Crutzen P & Stoermer E (2000). The Anthropocene. *Global Change Newsletter*, 41, 17-18

da Conceição-Heldt, E., & Mello, P. A. (2017). Two-Level Games in Foreign Policy Analysis. In E. da Conceição-Heldt & P. A. Mello, *Oxford Research Encyclopedia of Politics*. Oxford University Press. https://doi.org/10.1093/acrefore/9780190228637.013.496

David R & Bauer F (1972). Constructing confidence sets using rank statistics. Journal of the American Statistical Association 67, 687–690. doi: 10.1080/01621459.1972.10481279

de Munck, V. (1994). A Micro-, Meso-, and Macro-level Descriptive Analysis of Disputes within a Social Network. A Study of Household Relations in a Sri Lankan Community. *Nomos Verlagsgesellschaft MbH*, 11.

Duşa, A. (2019). *QCA with R*. Springer International Publishing. https://doi.org/10.1007/978-3-319-75668-4

Dye, Thomas R. (1972) Understanding Public Policy. Englewood Cliffs: Prentice-Hall

Eckstein, D., Hutfils, M.-L., Winges, M., & Germanwatch. (2018). *Global Climate Risk Index 2019 Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2017 and 1998 to 2017*.

Eliason, S. R., & Stryker, R. (2009). Goodness-of-Fit Tests and Descriptive Measures in Fuzzy-Set Analysis. *Sociological Methods & Research*, *38*(1), 102–146. https://doi.org/10.1177/0049124109339371

Eyestone R (1977). Confusion, Diffusion and Innovation. *American Political Science Review*, 71, 441-53

Fenn, P., & Veljanovski, C. G. (1988). A Positive Economic Theory of Regulatory Enforcement. *The Economic Journal*, *98*(393), 1055. https://doi.org/10.2307/2233719

Fiorino, D. J. (2011). Explaining national environmental performance: Approaches, evidence, and implications. *Policy Sciences*, *44*(4), 367–389.

Gupta, J. (2010). A history of international climate change policy: History of international climate change policy. *Wiley Interdisciplinary Reviews: Climate Change*, *1*(5), 636–653. https://doi.org/10.1002/wcc.67

Hasson, R., Löfgren, Å., & Visser, M. (2010). Climate change in a public goods game: Investment decision in mitigation versus adaptation. *Ecological Economics*, *70*(2), 331–338. https://doi.org/10.1016/j.ecolecon.2010.09.004

Hollander M & Wolfe D.A (1973). Nonparametric Statistical Methods. New York: John Wiley & Sons. Pages 27–33 (one-sample), 68–75 (two-sample).

Holzinger, K., Knill, C., & Sommerer, T. (2011). Is there convergence of national environmental policies? An analysis of policy outputs in 24 OECD countries. *Environmental Politics*, *20*(1), 20–41. https://doi.org/10.1080/09644016.2011.538163

Hovi, J., Sprinz, D. F., & Bang, G. (2012). Why the United States did not become a party to the Kyoto Protocol: German, Norwegian, and US perspectives. *European Journal of International Relations*, *18*(1), 129–150. https://doi.org/10.1177/1354066110380964

Howlett M. & Cashore B. (2014). "Conceptualizing Public Policy." In *Comparative Policy Studies: Conceptual and Methodological Challenges*, eds. Isabelle Engeli and Christine Rothmayer Allison. Houndmills, UK: Palgrave Macmillan, 17–34.

Howlett, M. (2009). Governance modes, policy regimes and operational plans: A multi-level nested model of policy instrument choice and policy design. *Policy Sciences*, *42*(1), 73–89. https://doi.org/10.1007/s11077-009-9079-1

Howlett, M., & Cashore, B. (2009). The Dependent Variable Problem in the Study of Policy Change: Understanding Policy Change as a Methodological Problem. *Journal of Comparative Policy Analysis: Research and Practice*, *11*(1), 33–46. https://doi.org/10.1080/13876980802648144

Ingold, K., Varone, F., Kammerer, M., Metz, F., Kammermann, L., & Strotz, C. (2019). Are responses to official consultations and stakeholder surveys reliable guides to policy actors' positions? *Policy & Politics*, *48*(2), 193–222. https://doi.org/10.1332/030557319X15613699478503

IPCC (2007): Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 976pp.

Jahn, D. (2014). Changing of the guard: Trends in corporatist arrangements in 42 highly industrialized societies from 1960 to 2010. *Socio-Economic Review*, *14*(1), 47–71. https://doi.org/10.1093/ser/mwu028

Jahn, D. (1998). Environmental Performance and Policy Regimes: Explaining Variations in 18 OECD-Countries. *Policy Sciences*, *31*, 107–131.

Jänicke, M. (1996). Democracy as a condition for environmental policy success: The importance of non-institutional factors. In W. M. Lafferty Problems and prospect, 71-85

Jänicke, M. (2017). The Multi-level System of Global Climate Governance - the Model and its Current State: The Multi-level System of Global Climate Governance. *Environmental Policy and Governance*, *27*(2), 108–121. https://doi.org/10.1002/eet.1747

Jordaan, S. M., Davidson, A., Nazari, J. A., & Herremans, I. M. (2019). The dynamics of advancing climate policy in federal political systems. *Environmental Policy and Governance*, *29*(3), 220–234. https://doi.org/10.1002/eet.1849

Kerr C (1983). *The Future of Industrial Societies: Convergence or Continuing Diversity?* Harvard University Press

Knill, C., Schulze, K., & Tosun, J. (2012). Regulatory policy outputs and impacts: Exploring a complex relationship: Regulatory policy outputs and impacts. *Regulation & Governance*, *6*(4), 427–444. https://doi.org/10.1111/j.1748-5991.2012.01150.x

Kunz, N. C., Fischer, M., Ingold, K., & Hering, J. G. (2015). Why Do Some Water Utilities Recycle More 987 than Others? A Qualitative Comparative Analysis in New South Wales, Australia. 988 *Environmental Science & Technology, 49*(14), 8287-8296. doi: 10.1021/acs.est.5b01827

Liefferink D, Arts B, Kamstra J, Ooijevar J (2009) Leaders and laggards in environmental policy: A quantitative analysis of domestic policy outputs. *Journal of European public policy*, 16, 677-700

Lijphart, A. (1999). Interest Groups: Pluralism Versus Corporatism. In *Patterns of Democracy* (pp. 158–173). Yale University Press.

Li Q & Reuveny R (2006). Democracy and environmental degradation. *International studies quarterly*, 50, 935-956

Majone, G. (2014). Policy Harmonization: Limits and Alternatives. *Journal of Comparative Policy Analysis: Research and Practice*, *16*(1), 4–21. https://doi.org/10.1080/13876988.2013.873191

Marks G. 1993. Structural policy and multi-level governance in the EC. In The State of the European Community vol. 2: The Maastricht Debates and Beyond, Cafruny AW, Rosenthal G (eds). Lynne Reiner: Boulder, CO.

Marshall, M. G., Gurr, T. R., & Jaggers, K. (2019). *POLITY IV PROJECT: Dataset Users' Manual*. Center for Systemic Peace. http://www.systemicpeace.org/inscrdata.html

Martin Bland, J. (2009). *Analysis of continuous data from small samples*. https://doi.org/10.1136/bmj.a3166

May, Peter J (2003). "Policy Design and Implementation." In *Handbook of Public Administration*, ed. B. Guy Peters and Jon Pierre. London: SAGE, 223–33.

Michaelowa, A., & Michaelowa, K. (2015). Do rapidly developing countries take up new responsibilities for climate change mitigation? *Climatic Change*, *133*(3), 499–510. https://doi.org/10.1007/s10584-015-1528-6

NDC Global Outlook Report 2019. (n.d.). UNDP. Retrieved October 1, 2019, from https://www.undp.org/content/undp/en/home/librarypage/environment-energy/climate_change/ndc-global-outlook-report-2019.html

Neumayer, E. (2003). Are left-wing party strength and corporatism good for the environment? Evidence from panel analysis of air pollution in OECD countries. *Ecological Economics*, *45*(2), 203–220. https://doi.org/10.1016/S0921-8009(03)00012-0

Neumayer, E. (2002). Do Democracies Exhibit Stronger International Environmental Commitment? A Cross-country Analysis. *Journal of Peace Research*, *39*(2), 139–164. https://doi.org/10.1177/0022343302039002001

North American Industry Classification System. (2017). Executive Office of the President, Office of Management and Budget.

OECD, European Union, & Joint Research Centre - European Commission. (2008). *Handbook on Constructing Composite Indicators: Methodology and User Guide*. OECD. https://doi.org/10.1787/9789264043466-en

OECD (2016). *Indicative Table to Guide Rio Marking by (Sub-)Sector*.

Offe, C. (1981). 'The attribution of public status to interest groups,' in S. D. Berger, ed., Organizing Interests in West Europe. Cambridge: Cambridge University

Ostrom, E. (1999). Coping With Tragedies of the Commons. *Annual Review of Political Science*, *2*(1), 493–535. https://doi.org/10.1146/annurev.polisci.2.1.493

Ostrom, E. (2012). Nested externalities and polycentric institutions: Must we wait for global solutions to climate change before taking actions at other scales? *Economic Theory*, *49*(2), 353–369. https://doi.org/10.1007/s00199-010-0558-6

Paris Agreement. (2015). UNFCCC. https://unfccc.int/sites/default/files/english_paris_agreement.pdf

Pearce, R., & Yeo, S. (2015). *Paris Climate Talks: Who are the negotiating groups?* Carbon Brief. https://www.carbonbrief.org/interactive-the-negotiating-alliances-at-the-paris-climate-conference

Poloni-Staudinger L.M. (2008). Are consensus democracies more environmentally effective? *Environmental politics*, 17, 410-431

Putnam, R. D. (1988). Diplomacy and Domestic Politics: The Logic of Two-Level Games. *International Organization*, *42*(3), 427–460.

Ragin, C. (2009). Qualitative Comparative Analysis in using Fuzzy Sets (fsQCA). In B. Rihoux & C. Ragin (Eds.), *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques*. SAGE Publications, Inc. https://doi.org/10.4135/9781452226569

Ragin, C. (2008). *Redesigning Social Inquiry: Fuzzy Sets and Beyond*. The University of Chicago Press.

Ragin, C. (2017). *User's Guide to Fuzzy-Set / Qualitative Comparative Analysis*.

Ragin, C., & Davey, S. (2014). fs/QCA [Computer Programm], Version [2.5/3.0]. Irvine, CA: University 1017 of California.

Ragin, C., & Sonnett, J. (2008). Limited Diversity and Counterfactual Cases. In *Redesigning Social Inquiry: Fuzzy Sets and Beyond*. The University of Chicago Press.

Rogers, E. M. (1983). Diffusion of innovations. New York: Free Press.

Royston P(1982). An extension of Shapiro and Wilk's W test for normality to large samples. *Applied Statistics*, 31, 115–124. doi: 10.2307/2347973

Sánchez, M. J. S., Bhattacharya, S., & Marecoka, K. (2006). *IPCC Guidelines for National Greenhouse Gas Inventories*. Intergovernmental Panel on Climate Change.

Schaffrin, A., Sewerin, S., & Seubert, S. (2015). Toward a Comparative Measure of Climate Policy Output: Schaffrin/Sewerin/Seubert: Comparative Measure of Climate Policy Output. *Policy Studies Journal*, *43*(2), 257–282. https://doi.org/10.1111/psj.12095

Schneider, C. Q. 2018. "Realists and Idealists in QCA." *Political Analysis* 26(2): 246-254. DOI:10.1017/pan.2017.45

Schneider, C. Q., & Wagemann, C. (2006). Reducing complexity in Qualitative Comparative Analysis (QCA): Remote and proximate factors and the consolidation of democracy. *European Journal of Political Research*, *45*(5), 751–786. https://doi.org/10.1111/j.1475-6765.2006.00635.x

Schneider, C. Q., & Wagemann, C. (2012). *Set-Theoretic Methods for the Social Sciences: A Guide to Qualitative Comparative Analysis*. Cambridge University Press. https://doi.org/10.1017/CBO9781139004244

Scruggs, L. (2001). Is There Really a Link Between Neo-Corporatism and Environmental Performance? Updated Evidence and New Data for the 1980s and 1990s. *British Journal of Political Science*, *31*(04). https://doi.org/10.1017/S0007123401220262

Scruggs, L. A. (1999). Institutions and Environmental Performance in Seventeen Western Democracies. *British Journal of Political Science*, *29*(1), 1–31. https://doi.org/10.1017/S0007123499000010

Sehring, J., Korhonen-Kurki, K., & Brockhaus, M. (2013). *Qualitative Comparative Analysis (QCA): An application to compare national REDD+ policy processes*. https://doi.org/10.17528/cifor/004278

Sewerin, S. (2013). *Comparative Climate Politics: Patterns of Climate Policy Performance in Western Democracie*. Universität zu Köln.

Siaroff, A. (1999). Corporatism in 24 industrial democracies: Meaning and measurement. *European Journal of Political Research*, *36*(2), 175–205. https://doi.org/10.1111/1475-6765.00467

Sprinz, D., & Vaahtoranta, T. (1994). *The Interest-Based Explanation of International Environmental Policy*. 30.

Sprinz, D., & Weiß, M. (2001). Domestic Politics and Global Climate Policy. In *International Relations and Global Climate Change*. MIT Press.

Stafford, S. (2012). Do Carrots Work? Examining the Effectiveness of EPA's Compliance Assistance Program: Effectiveness of EPA's Compliance Assistance Program. *Journal of Policy Analysis and Management*, *31*(3), 533–555. https://doi.org/10.1002/pam.21633

Sutter, P. (2017). *Making Climate Change History: Documents from Global Warming's Past* (J. Howe, Ed.). University of Washington Press.

Taibi, F.-Z., & Konrad, S. (2018). *Pocket Guide to NDCs under the UNFCCC*. European Capacity Building Initiative.

Thomann, E., & Maggetti, M. (2017). Designing Research with Qualitative Comparative Analysis (QCA): Approaches, Challenges, and Tools. *Sociological Methods & Research*, *49*(2), 356–386. https://doi.org/10.1177/0049124117729700

Teune, H. (1977). Macro Theoretical Approaches to Public Policy Analysis: The Fiscal Crisis of American Cities. The Annals of the American Academy of Political and Social Science, 434, 174-185

Tubi, A., Fischhendler, I., & Feitelson, E. (2012). The effect of vulnerability on climate change mitigation policies. *Global Environmental Change*, *22*(2), 472–482. https://doi.org/10.1016/j.gloenvcha.2012.02.004

United Nations. (n.d.). *Member States*. https://www.un.org/en/member-states/

Upadhyaya P; Fridahl M; Linnér BO; Román M (2018): Comparing Climate Policy Processes in India, Brazil, and South Africa: Domestic Engagements With International Climate Policy Frameworks. *The Journal of Environment & Development 27*(2), 186–209

Weaver B (2015). *Minimum Sample Size, Single-Sample t-test*, [Blogpost]. https://www.researchgate.net/post/Minimum_sample_size_for_t-test

Weiler, F. (2012). Determinants of bargaining success in the climate change negotiations. *Climate Policy*, *12*(5), 552–574. https://doi.org/10.1080/14693062.2012.691225

World Economic Outlook Database. (2019). International Monetary Fund (IMF). https://www.imf.org/external/pubs/ft/weo/2019/01/weodata/index.aspx

Yeo, S. (2016). *Timeline: the Paris agreement's 'ratchet mechanism'.* Carbon Brief. https://www.carbonbrief.org/timeline-the-paris-agreements-ratchet-mechanism

10. Appendix

Table A. Modified taxonomy of policy components

	Policy Content		
	High level abstraction	Programme level operationalization	Specific on-the-ground measures
Policy ends or aims	Goals *What general types of ideas govern policy development?* (e.g. environmental protection, economic development)	Objectives *What does policy formally aim to address?* (e.g. saving wilderness of species habitat, increasing harvesting levels to create processing jobs)	Settings *What are the specific on-the-ground requirement of policy?* (e.g. considerations about the optimal size of designated stream-bed riparian zones, or sustainable harvesting)
	Policy focus		
Policy means or tools	Instrument Logic *What general norms guide implementation preferences?* (e.g. preferences for the use of coercive instruments, or moral suasion)	Mechanisms *What specific type of instruments are utilized?* (e.g. the use of different tools such as tax incentives, or public enterprises)	Calibrations *What are the specific ways in which the instrument is used?* (e.g. designation of higher levels of subsidies, the use of mandatory vs voluntary regulatory guidelines or standards

source: Howlett & Cashore (2009)

Table B. Climate Policy Intensity Measures, Coding Scheme and Aggregation Rules

Intensity Measure	Coding Question	Coding Values	Specific Aggregation to Final Value	Range
Objectives	What is the policy objective w/respect to policy performance?	0 = no specific target given objective for absolute emission reduction objective for absolute increase in energy production from renewable sources	We calculated the share of the policy instruments' objective for absolute emission reduction or absolute increase in energy production from renew energy sources on the benchmark of 80% emission reduction on the basis of 1990 levels or 100% energy production from renewable sources in 2050	0-1
Scope	Does the policy include branches of both supply and demand side?	0 = only one target group included 0.16 = for each target group households/companies demand/supply 0.5 = all groups targeted	Additive aggregation	0-1
	Are all mitigation actions targeted?	0 = only one mitigation action targeted 0.05 = for each additional action out of oil, gas, coal, wind, solar, biomass, hydro, and CHP 0.15 = energy efficiency target		
Integration	Is the policy instrument integrated in a package or any reference to other policy instruments? Is the framework policy included?	0 = no 0.5 = yes 1 = yes, including framework policy	Additive aggregation	0, 0.5, 1
Budget	What are the set expenditures/impositions of the policy instrument?	0 = no fixed costs/impositions Absolute annual costs/impositions of policy instrument	The values of intensity if calculated as the share of the public expenditure or imposition for the policy instrument on total public expenditure for energy and fuels or direct public revenue from the revenues of the value added tax (0-1)	0 - 1
Implementation	Is there a statement about implementation procedures specifically allocating actors and rules?	0 = no statement about implementation procedures found 0.25 = implementation is specifically allocated to actors and rules 0.25 = only one specific actor coordinated implementation	Additive aggregation	0, 0.25, 0.75, 1
	How is the implementation planned and is there sanctioning?	0.25 = implementation procedure is strict in the sense that it does not allow a range or change in standards or rules 0.25 = there is sanctioning for actors not complying to the implementation procedure		
Monitoring	Is there a specific monitoring process for the policy instrument and by whom?	0 = no monitoring 0.5 = monitoring by the implementing agency 1 = a special group/institution is established for monitoring	Additive aggregation	0,0.5,1

Source: Schaffrin et al. 2015

Table C. National strategies, plans, policies

Country	Selected Documents	Year Adopted	Period
Australia	(Pol_1) National Energy Productivity Plan 2015-2030	2015	2015-2030
Brazil	(Pol_1) Law 12.187/2009, National Policy on Climate Change	2010	2010-2020
Canada	(Pol_1) Pan-Canadian Framework on Clean Growth and Climate Change	2016	2016-2030
China	(Pol_1) Chp. 46: Respond to Global Climate Change of 13th Five-Year Plan (Translated Work Plan for Controlling Greenhouse Gas Emission provided by Asia Pacific Energy Portal); (Pol_2) National Plan For Tackling Climate Change 2014-2020; (Pol_3) 12th Five-Year Plan for the Development of National Economy and Society	(Pol_1) 2016 (Pol_2) 2014 (Pol_3) 2011	(Pol_1) 2016-2020 (Pol_2) 2014-2020 (Pol_3) 2011-2015
Germany	(Pol_1) Climate Action Plan 2050; (Pol_2) Action Programme on Climate Protection 2020; (Pol_3) Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply; (Pol_4) Integrated Climate and Energy Programme (IEKP)	(Pol_1) 2016 (Pol_2) 2014 (Pol_3) 2010 (Pol_4) 2008*	(Pol_1) 2016-2030 (Pol_2) 2014-2020 (Pol_3) 2010-2050 (Pol_4) 2007-2020
India	(Pol_1) National Policy on Biofuels	2009	2009-2017
Indonesia	(Pol_1) National Medium Term Development Plan (RPJMN) 2015-2019; (Pol_2) Presidential Decree 61/2011, National Action Plan to reduce GHG emissions (RAN-GRK)	(Pol_1) 2015 (Pol_2) 2011	(Pol_1) 2015-2019 (Pol_2) 2011-2020
Iran	(Pol_1) Law on Altering Energy Consumption Patterns	2011	2011-2020
Japan	(Pol_1) Plan for Global Warming Countermeasures	2016	2016-2050**
Korea, Republic of	(Pol_1) National Roadmap for Greenhouse Gas Reductions by 2030	2018*	2016-2030
Mexico	(Pol_1) General Law on Climate Change; (Pol_2) National Climate Change Strategy	(Pol_1) 2018* (Pol_2) 2007	(Pol_1) 2012-2050** (Pol_2) 2007-2050**
Russian Federation	(Pol_1) Energy Strategy to 2030	2009	2009-2030
South Africa	(Pol_1) National Energy Efficiency Strategy	2019	2030
Switzerland	(Pol_1) CO2 Act (Act 641.71, fully revised version)	2013	2013-2020
Thailand	(Pol_1) Thailand Power Development Plan 2015-2036	2015	2015-2036
Turkey	(Pol_1) Climate Change Strategy 2010-2020	2010	2010-2020
United Kingdom	(Pol_1) Climate Change Act; (Pol_2) Climate Change Programme 2006	(Pol_1) 2019* (Pol_2) 2006	(Pol_1) 2008-2050 (Pol_2) 2006-2010
United States	(Pol_1) Clean Power Plan	2016***	2015-2030

*Date amended **Multiple target years, latest year ***Stayed Implementation

Table D. Measures of National Policy Output (X_{nat})

Country	Pol_1	Pol_2	Pol_3	Pol_4
AUS	0.317	–	–	–
BRA	0.450	–	–	–
CAN	0.967	–	–	–
CHN	0.192	0.664	0.503	–
DEU	1.025	0.733	1.125	0.700
IND	0.050	–	–	–
INS	0.398	0.804	–	–
IRN	0.383	–	–	–
JPN	1.376	–	–	–
KOR	0.626	–	–	–
MEX	1.224	1.074	–	–
RUS	0.767	–	–	–
SAF	0.367	–	–	–
CHE	0.517	–	–	–
THI	0.200	–	–	–
TUR	0.578	–	–	–
UKG	1.033	0.633	–	–
USA	0	–	–	–

Table E. Sector Categorization

Sector	Contents
Energy	*extraction, generation, distribution, and consumption of primary & final energy*
Electricity & Heat	Electricity & Heat plants (fossil fuels)
	- Public plants (electricity, heat, CHP)
	- Auto producers (electricity, heat, CHP)
	Other Energy Industries (fossil fuels)
	Transmission & Distribution
Transportation	Road, air, rail, ship & other
Other Fuel Combustion	Biomass Combustion
	Gas/Venting
Fugitive Emissions	Oil & Natural Gas Systems
	Coal Mining
Buildings	Residential & Commercial
Industry	*transformation of materials, substances, or components into new products*
	Product use
	Manufacturing & Construction
	Cement
	Adipic and Nitric Acid Production
	Aluminum
	Other Industrial non-Agriculture
	All F-gases
Agriculture	*production & emissions that can be allocated to agriculture activities*
	Enteric Fermentation (Livestock)
	Manure Management
	Rice Cultivation
	Agricultural Soils
	Other Agricultural Sources
LULUC & Forestry	*harvesting and managing land and forests*
	Land clearing for permanent use
	Timber & logging
Waste	*collection, treatment, disposal and other remedial services*
	Landfills (Solid Waste)
	Wastewater Treatment
	Human Sewage
	Other

adapted from: Baumert et al. 2005; Sanchez et al. 2006; North 2017; OECD 2016

Table F. End-Use/Activity Definitions

End-Use/Activity	*Contents*	*Related Category(s)*
Road	Direct fuel combustion	Energy: Transportation
Air	Domestic air (direct fuel combustion)	"
	International air (direct fuel combustion)	"
Rail, Ship, & Other	Rail (electricity)	"
	International marine (direct fuel combustion)	"
	Pipeline transport, national navigation, and others (direct fuel combustion)	"
	Pipeline transport (electricity)	"
	Non-specified transport (electricity)	"
Transmission & Distribution Losses	Distribution losses	Energy: Electricity & Heat
	Electrical transmission & distribution	"
Residential Buildings	Direct fuel combustion (on-site)	Energy: Buildings
	Electricity and heat consumption (indirect)	"
Commercial Buildings	Direct fuel combustion (on-site)	"
	Electricity and heat consumption (indirect)	"
Unallocated Fuel Combustion	Forestry/fishing and other direct fossil fuel combustion not specified elsewhere	LULUC & Forestry
	Biomass combustion	Energy: Other Fuel Combustion
	Stationary & mobile sources	"
	Own use in electricity, CHP and heat plants (elect. & heat)	Energy: Electricity & Heat
	Pumped storage (electricity)	"
	Nuclear Industry (electricity & heat)	"
	Non-specified & other (electricity & heat)	"
Iron & steel	Direct fuel combustion	Industry
	Electricity and heat consumption (indirect)	"
Non-Ferrous Metals	Direct fuel combustion (on-site)	Industry: Manufacturing & Const.
Chemicals & Petrochemicals	Direct fuel combustion	Industry: Manufacturing & Const.
	Electricity and heat consumption	"
	Adipic and nitric acid	"
	ODS substitutes	"
	HCFC-22 production	"
Cement Manufacture	Direct fuel combustion	Industry: Manufacturing & Const.
	Electricity and heat consumption	"
	Clinker production	"
Other Industry	Transport equipment (direct combustion, electricity, heat)	Industry: Manufacturing & Const.
	Mining & quarrying (direct combustion, electricity, heat)	Energy: Electricity & Heat
	Wood/wood products (direct combustion, electricity, heat)	Industry: Manufacturing & Const.
	Construction (direct combustion, electricity, heat)	"
	Textile & leather (direct combustion, electricity, heat)	"
	Non-metallic minerals excluding cement (direct combustion, electricity, heat)	"
	Other & non-specified (direct combustion, electricity, heat)	"
	Semiconductors	"
	Other industrial non-agriculture	"
	Other high GWP gases	"
Coal Mining & Manufacture	Coal mining	Energy: Fugitives
	Coal mines (electricity & heat)	Energy: Electricity & Heat
	Fuel combustion for the manufacture of hard coal, coke oven coke, and other coal-related fuels	"
Oil & Gas Extraction, Refining, Processing	Gas Flaring	Energy: Fugitives
	Oil & natural gas systems	"
	Oil & gas extraction (electricity and heat)	Energy: Electricity & Heat

	Electricity and heat consumption (indirect)	"
	Aluminum	"
	Magnesium	"
Machinery	Direct fuel combustion	"
	Electricity and heat consumption	"
Pulp, Paper, & Printing	Direct fuel combustion	Industry: Manufacturing & Const.
	Electricity and heat consumption	"
Food & Tobacco	Direct fuel combustion	Industry: Manufacturing & Const.
	Electricity and heat consumption	"
Other Agriculture	Misc. Agricultural process	Agriculture
	Electricity and heat (public) consumed in oil refineries, coke ovens and other energy producing plants	"
	Fuel combusted in refineries, gas processing plants, and other energy-producing industries	"
Land-Use Change & Forestry	Land clearing for permanent croplands (cultivation) or pastures (no cultivation), abandonment (with subsequent regrowth), shifting cultivation, and wood harvest.	Land-Use Change & Forestry
Energy-related agriculture	Direct fuel combustion	Energy: Other Fuel Combustion
	Electricity and heat consumption	Energy: Electricity & Heat
Agricultural Soils	Fertilizer application	Agriculture
Livestock & Manure	Enteric fermentation (livestock)	Agriculture
	Manure management	"
Rice cultivation	Rice cultivation	Agriculture

sources: (Baumert et al. 2005; Sanchez et al. 2006)

Table G. Climate Action Tracker Rating system

Categorization	Description	Assigned value
Role Model	NDC is more ambitious than what is considered a "fair" contribution: it is more than consistent with the Paris Agreement's 1.5˚C limit.	1
1.5˚C Paris Agreement Compatible	NDC is consistent with the Paris Agreement 1.5˚C limit.	0.8
2˚C Compatible	NDC is consistent with the 2009 Copenhagen 2˚C goal, but are not fully consistent with the Paris Agreement long term temperature goal.	0.6
Insufficient	NDC is not consistent with holding warming below 2˚C let along the Paris Agreements stronger 1.5˚C limit.	0.4
Highly insufficient	NDC is not at all consistent with holding warming below 2˚C.	0.2
Critically insufficient	NDC is well outside a country's fair shar range and not at all consistent with 2˚C limit.	0

Source: Climate Action Tracker 2020

Table H. Normalized Scores

	X_{int}			X_{nat}		$X_{AVG.}$		X_{Δ}	
	VPHI	CCPI	CAT	VPHI	CCPI	VPHI	CCPI	VPHI	CCPI
AUS	0.393	0.000	0.667	0.230	0.000	0.231	0.000	0.771	0.411
BRA	0.541	0.214	0.667	0.327	0.425	0.363	0.361	0.708	0.107
CAN	0.426	0.932	0.667	0.703	0.434	0.714	0.723	0.310	0.821
CHE	0.754	0.712	0.667	0.376	0.594	0.458	0.710	0.706	0.403
CHN	1.000	0.805	0.333	0.329	1.000	0.467	1.000	0.807	0.000
DEU	0.590	1.000	0.667	0.651	0.561	0.700	0.833	0.397	0.734
UKG	0.590	0.949	0.667	0.605	0.858	0.654	0.986	0.442	0.319
IND	0.508	0.814	1.000	0.036	0.840	0.063	0.908	0.989	0.205
INS	0.410	0.610	0.333	0.438	0.292	0.444	0.478	0.569	0.669
IRN	0.000	0.508	na	0.278	0.717	0.193	0.683	0.637	0.047
JPN	0.361	0.254	0.333	1.000	0.226	1.000	0.262	0.000	0.390
KOR	0.377	0.551	0.333	0.455	0.654	0.455	0.666	0.545	0.167
MEX	0.295	0.475	0.667	0.835	0.377	0.820	0.462	0.149	0.428
RUS	0.426	0.576	0.000	0.557	0.222	0.568	0.419	0.454	0.722
SAF	0.361	0.823	0.333	0.267	0.198	0.261	0.527	0.728	1.000
THI	0.098	0.424	na	0.145	0.434	0.081	0.471	0.791	0.308
TUR	0.279	0.028	0.000	0.420	0.075	0.397	0.059	0.558	0.347
USA	0.393	0.000	0.000	0.000	0.057	0.000	0.034	1.000	0.341
mean	0.434	0.538	0.458	0.425	0.443	0.437	0.532	0.587	0.412

Table I. Countries membership scores in configurations of democracy, vulnerability and abatement costs

1 of 2

Cases	Membership in conditions			Membership in configurations				Outcome	
	DEM	VUL	ABT	DEM*VUL*ABT	DEM*VUL*~ABT	DEM*~VUL*ABT	~DEM*VUL*ABT	VPH	~VPH
AUS	0.95	0.8	0.26	0.26	0.74	0.2	0.05	0.39	0.61
BRA	0.92	0.51	0.17	0.17	0.51	0.17	0.08	0.54	0.46
CAN	0.95	0.44	0.18	0.18	0.44	0.18	0.05	0.40	0.6
CHN	0.11	0.8	0.78	0.11	0.22	0.11	0.78	0.32	0.68
DEU	0.95	0.86	0.11	0.11	0.86	0.11	0.05	0.66	0.34
IND	0.93	0.89	0.74	0.74	0.26	0.11	0.07	0.09	0.91
INS	0.67	0.63	0.53	0.53	0.47	0.37	0.33	0.93	0.07
IRN	0.25	0.61	0.63	0.25	0.25	0.25	0.61	0.80	0.2
JPN	0.95	0.49	0.09	0.09	0.49	0.09	0.05	0.05	0.95
KOR	0.9	0.58	0.29	0.29	0.58	0.29	0.1	0.95	0.05
MEX	0.86	0.74	0.29	0.29	0.71	0.26	0.14	0.15	0.85
RUS	0.79	0.82	0.72	0.72	0.28	0.18	0.21	0.84	0.16
SAF	0.93	0.58	0.6	0.58	0.4	0.42	0.07	0.48	0.52
CHE	0.95	0.79	0.06	0.06	0.79	0.06	0.05	0.55	0.45
THI	0.86	0.89	0.52	0.52	0.48	0.11	0.14	0.35	0.65
TUR	0.9	0.31	0.2	0.2	0.31	0.2	0.1	0.94	0.06
UKG	0.95	0.68	0.11	0.11	0.68	0.11	0.05	0.81	0.19
USA	0.95	0.84	0.19	0.19	0.81	0.16	0.05	0.09	0.91

Cases	Membership in conditions			Membership in configurations				Outcome	
	DEM	VUL	ABT	~DEM*VUL*~ABT	~DEM*~VUL*ABT	DEM*~VUL*~ABT	~DEM*~VUL*~ABT	VPH	~VPH
AUS	0.95	0.8	0.26	0.05	0.05	0.2	0.05	0.39	0.61
BRA	0.92	0.51	0.17	0.08	0.08	0.49	0.08	0.54	0.46
CAN	0.95	0.44	0.18	0.05	0.05	0.56	0.05	0.40	0.6
CHN	0.11	0.8	0.78	0.22	0.2	0.11	0.2	0.32	0.68
DEU	0.95	0.86	0.11	0.05	0.05	0.14	0.05	0.66	0.34
IND	0.93	0.89	0.74	0.07	0.07	0.11	0.07	0.09	0.91
INS	0.67	0.63	0.53	0.33	0.33	0.37	0.33	0.93	0.07
IRN	0.25	0.61	0.63	0.37	0.39	0.25	0.37	0.80	0.2
JPN	0.95	0.49	0.09	0.05	0.05	0.51	0.05	0.05	0.95
KOR	0.9	0.58	0.29	0.1	0.1	0.42	0.1	0.95	0.05
MEX	0.86	0.74	0.29	0.14	0.14	0.26	0.14	0.15	0.85
RUS	0.79	0.82	0.72	0.21	0.18	0.18	0.18	0.84	0.16
SAF	0.93	0.58	0.6	0.07	0.07	0.4	0.07	0.48	0.52
CHE	0.95	0.79	0.06	0.05	0.05	0.21	0.05	0.55	0.45
THI	0.86	0.89	0.52	0.14	0.11	0.11	0.11	0.35	0.65
TUR	0.9	0.31	0.2	0.1	0.1	0.69	0.1	0.94	0.06
UKG	0.95	0.68	0.11	0.05	0.05	0.32	0.05	0.81	0.19
USA	0.95	0.84	0.19	0.05	0.05	0.16	0.05	0.09	0.91

Table J. Countries membership scores in configurations of democracy, corporatism, vulnerability and abatement costs

1 of 4

Cases	Membership in conditions				Membership in configurations					Outcome	
	DEM	CORP	VUL	ABT	DEM*CORP* VUL*ABT	DEM*CORP* VUL*~ABT	DEM*CORP* ~VUL*ABT	DEM*~CORP *VUL*ABT	~DEM*CORP *VUL*ABT	VPH	~VPH
AUS	0.95	0.5	0.8	0.26	0.26	0.5	0.2	0.26	0.05	0.39	0.61
BRA	0.92	0.34	0.51	0.17	0.17	0.34	0.34	0.17	0.08	0.54	0.46
CAN	0.95	0.06	0.44	0.18	0.06	0.06	0.06	0.18	0.05	0.40	0.6
DEU	0.95	0.83	0.86	0.11	0.11	0.83	0.11	0.11	0.05	0.66	0.34
IND	0.93	0.39	0.89	0.74	0.39	0.26	0.11	0.74	0.07	0.09	0.91
JPN	0.95	0.16	0.49	0.09	0.09	0.16	0.09	0.09	0.05	0.05	0.95
KOR	0.9	0.48	0.58	0.29	0.29	0.48	0.29	0.29	0.1	0.95	0.05
MEX	0.86	0.19	0.74	0.29	0.19	0.19	0.19	0.29	0.14	0.15	0.85
SAF	0.93	0.83	0.58	0.6	0.58	0.4	0.42	0.17	0.07	0.48	0.52
CHE	0.95	0.51	0.79	0.06	0.06	0.51	0.06	0.06	0.05	0.55	0.45
UKG	0.95	0.09	0.68	0.11	0.09	0.09	0.09	0.11	0.05	0.81	0.19
USA	0.95	0.05	0.84	0.19	0.05	0.05	0.05	0.19	0.05	0.09	0.91

Cases	Membership in conditions				Membership in configurations					Outcome	
	DEM	CORP	VUL	ABT	~DEM*CORP *VUL*~ABT	~DEM*CORP * ~VUL*ABT	~DEM*~COR P*VUL*ABT	~DEM*~COR P*VUL*~ABT	~DEM*~COR P*~VUL*~AB T	VPH	~VPH
AUS	0.95	0.5	0.8	0.26	0.05	0.05	0.05	0.05	0.05	0.39	0.61
BRA	0.92	0.34	0.51	0.17	0.08	0.08	0.08	0.08	0.08	0.54	0.46
CAN	0.95	0.06	0.44	0.18	0.05	0.05	0.05	0.05	0.05	0.40	0.6
DEU	0.95	0.83	0.86	0.11	0.05	0.05	0.05	0.05	0.05	0.66	0.34
IND	0.93	0.39	0.89	0.74	0.07	0.07	0.07	0.07	0.07	0.09	0.91
JPN	0.95	0.16	0.49	0.09	0.05	0.05	0.05	0.05	0.05	0.05	0.95
KOR	0.9	0.48	0.58	0.29	0.1	0.1	0.1	0.1	0.1	0.95	0.05
MEX	0.86	0.19	0.74	0.29	0.14	0.14	0.14	0.14	0.14	0.15	0.85
SAF	0.93	0.83	0.58	0.6	0.07	0.07	0.07	0.07	0.07	0.48	0.52
CHE	0.95	0.51	0.79	0.06	0.05	0.05	0.05	0.05	0.05	0.55	0.45
UKG	0.95	0.09	0.68	0.11	0.05	0.05	0.05	0.05	0.05	0.81	0.19
USA	0.95	0.05	0.84	0.19	0.05	0.05	0.05	0.05	0.05	0.09	0.91

Cases	Membership in conditions				Membership in configurations					Outcome	
	DEM	CORP	VUL	ABT	DEM*~CORP *~VUL*~ABT	~DEM*CORP *~VUL*~ABT	~DEM*~CORP* ~VUL*ABT	DEM*~CORP *VUL*~ABT	DEM*~CORP * ~VUL*ABT	VPH	~VPH
AUS	0.95	0.5	0.8	0.26	0.2	0.05	0.05	0.5	0.2	0.39	0.61
BRA	0.92	0.34	0.51	0.17	0.49	0.08	0.08	0.51	0.17	0.54	0.46
CAN	0.95	0.06	0.44	0.18	0.56	0.05	0.05	0.44	0.18	0.40	0.6
DEU	0.95	0.83	0.86	0.11	0.14	0.05	0.05	0.17	0.11	0.66	0.34
IND	0.93	0.39	0.89	0.74	0.11	0.07	0.07	0.26	0.11	0.09	0.91
JPN	0.95	0.16	0.49	0.09	0.51	0.05	0.05	0.49	0.09	0.05	0.95
KOR	0.9	0.48	0.58	0.29	0.42	0.1	0.1	0.52	0.29	0.95	0.05
MEX	0.86	0.19	0.74	0.29	0.26	0.14	0.14	0.71	0.26	0.15	0.85
SAF	0.93	0.83	0.58	0.6	0.17	0.07	0.07	0.17	0.17	0.48	0.52
CHE	0.95	0.51	0.79	0.06	0.21	0.05	0.05	0.49	0.06	0.55	0.45
UKG	0.95	0.09	0.68	0.11	0.32	0.05	0.05	0.68	0.11	0.81	0.19
USA	0.95	0.05	0.84	0.19	0.16	0.05	0.05	0.81	0.16	0.09	0.91

Cases	Membership in conditions				Membership in configurations	Outcome	
	DEM	CORP	VUL	ABT	DEM*CORP* ~VUL*~ABT	VPH	~VPH
AUS	0.95	0.5	0.8	0.26	0.2	0.39	0.61
BRA	0.92	0.34	0.51	0.17	0.34	0.54	0.46
CAN	0.95	0.06	0.44	0.18	0.06	0.40	0.6
DEU	0.95	0.83	0.86	0.11	0.14	0.66	0.34
IND	0.93	0.39	0.89	0.74	0.11	0.09	0.91
JPN	0.95	0.16	0.49	0.09	0.16	0.05	0.95
KOR	0.9	0.48	0.58	0.29	0.42	0.95	0.05
MEX	0.86	0.19	0.74	0.29	0.19	0.15	0.85
SAF	0.93	0.83	0.58	0.6	0.4	0.48	0.52
CHE	0.95	0.51	0.79	0.06	0.21	0.55	0.45
UKG	0.95	0.09	0.68	0.11	0.09	0.81	0.19
USA	0.95	0.05	0.84	0.19	0.05	0.09	0.91

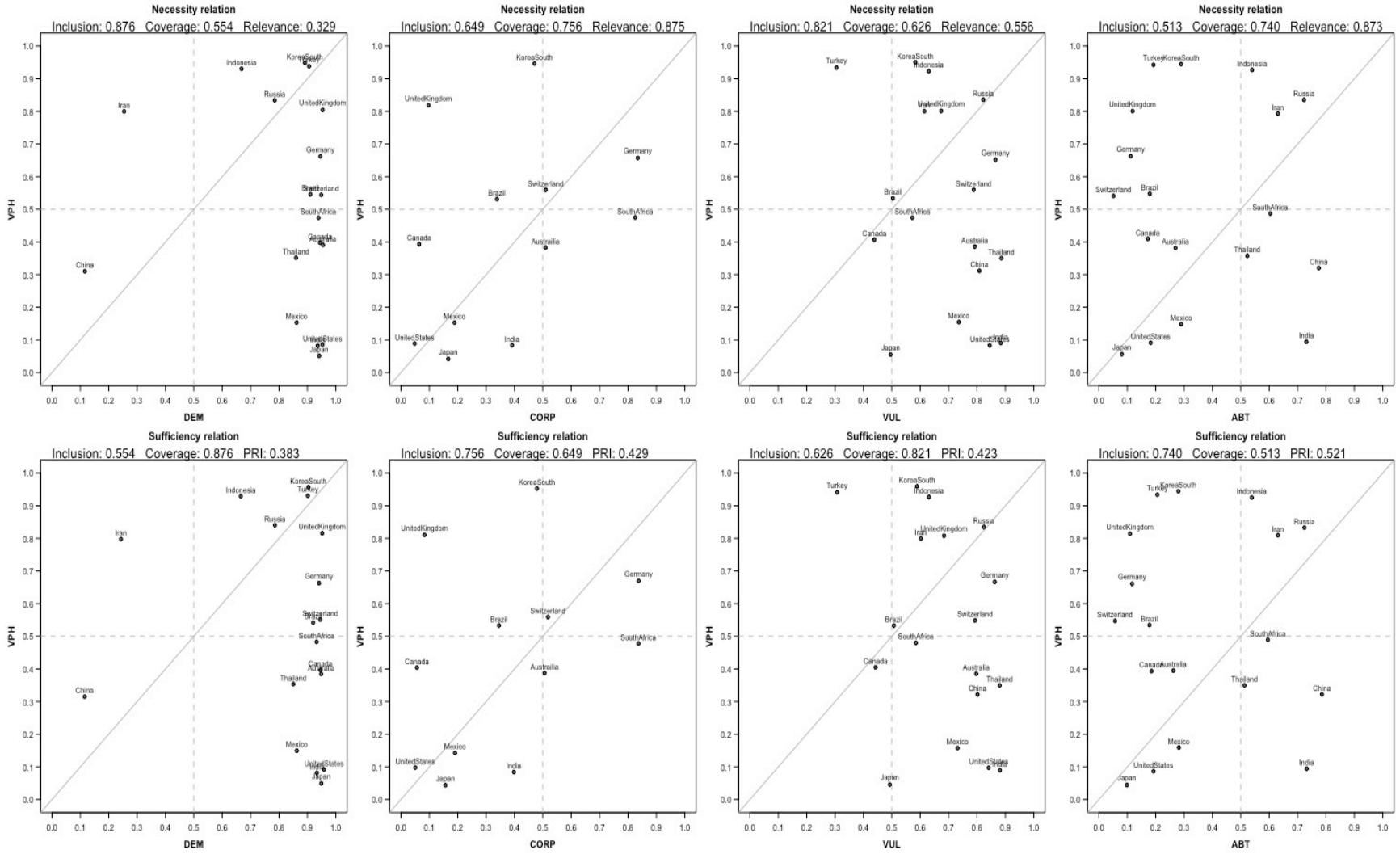
Table K. Sufficient Paths for Higher Levels of Vertical Policy Harmonization (Intermediate Solutions)

	Raw Coverage	Unique Coverage	Consistency
DEM*~VUL*~ABT	0.5	0.297645	0.850638
cases covered	*CAN, JPN, TUR*		
~DEM*VUL*ABT	0.269807	0.0674518	0.845638
cases covered	*CHN, IRN*		
solution coverage	0.567452		
solution consistency	0.805471		
	Raw Coverage	Unique Coverage	Consistency
DEM*CORP*VUL*~ABT	0.633721	0.633721	0.844961
cases covered	*DEU, CHE*		
solution coverage	0.633721		
solution consistency	0.844961		

Table L. Sufficient Paths for Higher Levels of Vertical Policy Harmonization (Parsimonious Solution)

	Raw Coverage	Unique Coverage	Consistency
~VUL	0.526767	0.299786	0.857143
cases covered	*CAN, JPN, TUR*		
~DEM	0.284797	0.0578158	0.82353
cases covered	*CHN, IRN*		
solution coverage	0.584582		
solution consistency	0.79708		
	Raw Coverage	Unique Coverage	Consistency
CORP*~ABT	0.633721	0.633721	0.844961
cases covered	*DEU, CHE*		
solution coverage	0.633721		
solution consistency	0.844961		

Figure A. XY plots of conditions' necessary and sufficient relations



A given condition can be inferred to be sufficient or necessary in cases below the diagonal line (Eliason and Stryker 2009).

11. Declaration of Consent

Declaration of consent

on the basis of Article 30 of the RSL Phil.-nat. 18

Name/First Name: Baker Jack

Registration Number: 18-116-285

Study program: MSc. in Climate Sciences with Special Qualification in Social Sciences

Bachelor ☐ Master ☑ Dissertation ☐

Title of the thesis: Indexing Vertical Policy Harmonization in the Two-Level Climate Change Regime

Supervisor: Prof. Dr. Karin Ingold

I declare herewith that this thesis is my own work and that I have not used any sources other than those stated. I have indicated the adoption of quotations as well as thoughts taken from other authors as such in the thesis. I am aware that the Senate pursuant to Article 36 paragraph 1 litera r of the University Act of 5 September, 1996 is authorized to revoke the title awarded on the basis of this thesis.
For the purposes of evaluation and verification of compliance with the declaration of originality and the regulations governing plagiarism, I hereby grant the University of Bern the right to process my personal data and to perform the acts of use this requires, in particular, to reproduce the written thesis and to store it permanently in a database, and to use said database, or to make said database available, to enable comparison with future theses submitted by others.

Bern 07.09.2020

Place/Date

Signature