Environmental Science and Pollution Research
https://doi.org/10.1007/s11356-018-2846-9

RESEARCH ARTICLE

Decentralization, national context and environmental policy performance: a fuzzy set qualitative comparative analysis

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Received: 26 April 2018 / Accepted: 25 July 2018

Abstract

This study examines the complex relationship between decentralization, national context and environment policy performance with the cross-sectional data from 118 countries. Decentralization is decomposed into three dimensions: political, fiscal and administrative. Both multiple regression analysis and fuzzy set qualitative comparative analysis are adopted. Results show that: (1) political, fiscal and administrative decentralization differ in their impacts on environmental policy performance. (2) There are multiple pathways, constituted by specific configurations of decentralization and context conditions, to high (or low) environmental policy performance. (3) High environmental policy performance occurs most often when a country is fiscally and administratively decentralized and its context is favorable, i.e. advanced economy, good governance and stringent environmental regulations. In this situation, political decentralization seems to be irrelevant to the outcome. (4) Low environmental policy performance occurs most often when a country, without the favorable context mentioned above, become fiscally centralized, regardless of whether political and administrative decentralization is present or not. This study suggests policy makers should keep in mind the contextual fit of decentralization and adopt a configurational thinking in environmental governance.

Keywords Tridimensional decentralization · National context · Environmental policy performance · Fuzzy-set qualitative comparative analysis

Introduction

In general, decentralization refers to the systematic and rational assignment of public functions from central government to the local level institutions (Smoke 2015). Recent decades have witnessed a continuing debate on the relationship between decentralization and environment policy performance (Sigman 2013; Kim and Yoon 2017). A huge number of scholars have advocated that decentralization has the potential to mitigate some pitfalls of centralized regimes, e.g. lack of local autonomy, arbitrary behavior and corruption, rigidity of policies (Treisman 2002; Schneider 2003). For example, under decentralization, the "vote with their feet" mechanism may urge local governments to provide better public goods and services, which leads to "*the race to the top*" (Tiebout 1956; Brennan and Buchanan 2006; Vogel 2009). However, decentralization may also lead to some destructive outcomes. For example, confronted with interjurisditional competition, local governments have incentives to employ excessively low standards of environmental protection to attract mobile capital, resulting in "*the race to the bottom*" (Prud'homme 1995; Levinson 2003; Woods 2006).

Beyond the debate, some scholars argue that the multidimensionality of decentralization (Treisman 2002; Schneider 2003; Ivanyna and Shah 2014) and the role of national context (Sepulveda and Martinez-Vazquez 2011; Kim and Yoon 2017) seem to be overlooked by the previous literature. For example, Kim and Yoon (2017) claim that whether decentralization can produce desirable environmental policy outcomes is contingent upon the capacity of government. This study aims to address these gaps by determining how multidimensional decentralization and contextual conditions jointly affect environmental policy performance. A new method called fuzzy set qualitative comparative analysis (fsQCA) is adopted. Quite different from traditional regression analysis, fsQCA assumes the real effects are not simply linear, additive and

Responsible editor: Nicholas Apergis

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Published online: 07 August 2018

unifinal. It focuses on which combinations of conditions can sufficiently produce the outcome of interest, rather than the net effects of individual variables (Ragin 2008; Schneider and Wagemann 2012).

This research contributes to existing knowledge about the complex relationship between decentralization, national context and environmental policy performance. First, it empirically examines the impacts of the three dimensions of decentralization, i.e. political, fiscal and administrative, on the environmental policy performance. Second, by using fsQCA, it reveals the merits of decentralization are contingent upon the specific national context and there are multiple pathways to high (or low) level of environmental policy performance. Third, it shows that fsQCA is complementary to traditional regression analysis in exploring the determinants of environmental policy performance.

The remainder of this paper proceeds as follows: the second section reviews the literature on the relationship between decentralization, national context and environment policy performance; the third section provides a detailed explanation of data, measurement and analytical strategy; the fourth section presents the results and the fifth section discusses their implications; the final section concludes, acknowledges limitations, and offers ideas for future research.

Literature review

Decentralization and environmental policy performance

Decentralization has become a widely discussed issue in the area of environmental policy and governance (Smith 1998; Ogawa and Wildasin 2009; Sigman 2013; Kim and Yoon 2017). Although decentralization is usually expected to be conducive to environmental policy performance, there is still controversy about its real effects. By taking a dialectic point of view, this study summarizes the various mechanisms by which decentralization is likely to affect environmental policy performance.

First, decentralization is likely to increase the decision-making autonomy of local governments. On the one hand, as local governments are empowered to provide "tailor-made" policy, decentralization is expected to be positively associated with environmental policy performance. In his foundational study, Oates (1972) argues that central governments find it difficult to implement public policy with optimal local variation. Peltzman and Tideman (1972) also posit that centralization tends to be inefficient if a high degree of heterogeneity exists among jurisdictions because the huge differences in local preferences make those small-sized jurisdictions suffer welfare losses. On the other hand, decentralization may generate more discretionary power for the local officials but weaker monitoring by central governments, which may give rise to the opportunities for local corruption (Prud'homme 1995). For example, using cross-country data, Lessmann and Markwardt (2010) find that decentralization tends to produce more corruption in countries without high degrees of press freedom. Further, an extensive literature on bureaucratic politics has shown that bureaucrats are likely to take advantages of such autonomy to pursue their personal interests rather than the public interests of local citizens (Tullock 1965; Niskanen 1971).

Second, decentralization is likely to intensify the interjurisdictional competition among local governments. As for the consequences of interjurisdictional competition, theoretical arguments can be classified into two groups: "*the race to the top*" and "*the race to the bottom*". The former arguments take an optimistic view, suggesting that interjurisdictional competition urges local governments to provide better public goods. According to the theory of Tiebout (1956), if the cost of mobility is low, the voters will relocate to the jurisdictions they prefer. This mechanism, so called "vote with their feet", prevents local governments from opportunistic behavior (Brennan and Buchanan 2006). For example, by examining the automobile emissions standards in the U.S., Vogel (2009) provides empirical evidence that shows interstate competition tends to generate stronger environmental standards. However, the latter advocates that, under the pressures of interjurisdictional competition, local governments have incentives to employ excessively low standards of environmental protection to attract mobile capital (Prud'homme 1995; Levinson 2003). In this case, interjurisdictional competition is destructive, resulting in the continued lowering of standards. For example, Woods (2006) finds that state enforcement stringency declines significantly in states in which the enforcement stringency exceeded their competitor's average during the previous year.

Third, decentralization is likely to enable local citizens to influence the processes of decision making and then hold local officials accountable. Under centralization, local officials are not really "local" because they are "not elected by local citizens but rather selected by higher-level governments" (Faguet 2014). As such, accountability for their performance is upward to the center, rather than downward to the local citizens. Decentralization changes their incentives and make them more responsive to the local needs. Furthermore, it reduces information asymmetry between public officials and local citizens, facilitating the public to bring environmental issues to the policy agenda (Kim and Yoon 2017). However, as some researchers have argued, decentralization may put some jurisdictions, especially those with small size, into the danger of special interest domination in the policy formation and implementation (Bardhan and Mookherjee 2006; Charron 2009). For instance, Hadiz (2004) finds that the decentralization process in Indonesia has largely been hijacked by interests that have little to gain from local governance characterized by greater accountability to local communities, transparency, and the like.

As is shown in the above review, the effect of decentralization on environmental policy performance remains inconclusive. To further our understanding of this issue, some scholars have argued that we need a multidimensional conceptualization of decentralization and pay more attention to the role of national context (Treisman 2002; Schneider 2003; Kim and Yoon 2017).

Tridimensional decentralization: political, fiscal and administrative

Beyond the general definition of decentralization, some scholars argue that it is essential to conceptualize decentralization as a multidimensional construct (Treisman 2002; Schneider 2003; Ivanyna and Shah 2014; Goel et al. 2017). For example, Schneider (2003) claims that those who overlook the multidimensional attributes of decentralization will risk drawing incorrect inferences about the relationship between decentralization and other phenomena. Based on these previous studies (Schneider 2003; Ivanyna and Shah 2014), decentralization can be decomposed into three dimensions, i.e. political, fiscal and administrative. This paper follows Ivanyna and Shah (2014) as they not only clearly identify each dimension of decentralization but also provide the measurement of them and related cross-national data. According to them, the definitions of political, fiscal and administrative decentralization can be summarized as follows.

1) *Political decentralization* refers to "home rule for local self-governance" (Ivanyna and Shah 2014). It is concerned with whether local authorities is directly elected by residents and to what degree the public can hold local officials accountable. In other words, it is an attribute of political regime and its level represents the potential of residents to control local government officials.
2) *Fiscal decentralization* is about the degree of autonomy owed by local government officials when they make the decisions about the fiscal expenditures and revenues. To be specific, it contains the autonomy to define tax bases and non-tax revenues as well as borrowing. Fiscal decentralization, also with the title of "fiscal federalism", has been widely discussed in the academic literature (Oates 1972; Altunbaş and Thornton 2011). It represents the amount of financial resources for local governance and deeply influences the behavioral logics of government officials.
3) *Administrative decentralization* implies the scope of action that local governments can hire and fire their employees without making any reference to the higher-level governments. This dimension of decentralization concerns to what degree local governments can arrange their organizational and personnel affairs by themselves. By implementing administrative decentralization, authorities and responsibilities are scaled down to the local governments, making them more functionally independent in organizational decision making.

With the tridimensional conceptualization of decentralization, it is reasonable to make three conjectures. First, a country is likely to be centralized in one or more dimensions but decentralized in the other. For example, the current China is widely recognized as a country that is politically centralized but fiscally decentralized (Montinola et al. 1995; Zhang 2006). Second, different dimensions of decentralization may exert different effects on environmental policy performance. Third, there may exist two-way or three-way interactions between these dimensions of decentralization. For example, Altunbaş and Thornton (2011) found that the curbing effect of fiscal decentralization on corruption can be mitigated by the reinforcement of administrative decentralization. Therefore, researchers should scrutinize each dimension of decentralization by revealing their separate and combinational effects on environmental policy performance.

The key role of national context

A central theme in comparative politics is that context matters (Franzese 2007). Recently, an increasing number of scholars highlight that how decentralization works is contingent upon the national context which includes factors like economic development, institutional quality and so on(Sepulveda and Martinez-Vazquez 2011; Kim and Yoon 2017). To capture the heterogeneity of national contexts, this paper includes three conditions that may affect environmental policy performance: two *structural* conditions (economic development and quality of governance) and one *intermediate* condition (stringency of environmental regulations). Here "structural" emphasizes that economic development and governance quality are something fundamental at work, while "intermediate" means that the stringency of environmental regulation, although constrained by socioeconomic conditions, affects environmental policy performance in more direct way. Figure 1 shows the conceptual framework employed by this paper.

Economic development

A plethora of studies have examined the impact of economic development on environmental performance, suggesting that economic development is generally conducive to the environment. As World Development Report in 1992 claimed: "As incomes rise, the demand for improvements in environmental quality will increase, as will the resources available for investment" (IBRD 1992). Economic development not only increases the environmental concerns of the public but also makes them more articulate and better equipped to assert their rights (Welzel and Inglehart 2008). However, some studies contend that economic development may initially damage

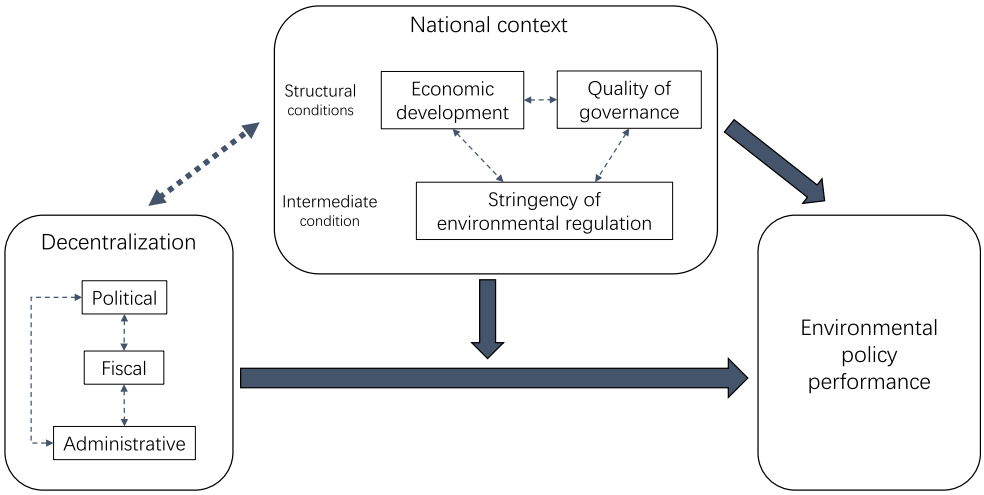

Fig. 1 The conceptual framework

the environment but enhance the quality of environment eventually, i.e. so-called Environmental Kuznets curve (Grossman and Krueger 1995; Stern et al. 1996). Beside its direct effects, economic development may interact with decentralization and then jointly affect environmental policy performance. On the one hand, advanced economy provides more resources to the local governments, enabling them to implement long-term environmental programs that require heavy investments. On the other hand, it can be expected that, in those countries with high income, citizens is more likely to pursue long-term public goods, such as environmental protection, rather than short-term projects that aims to satisfy their material needs. Therefore, local governments may face more pressures from the public to provide good environment.

Quality of governance

The quality of governance (or institutional quality) is the second structural condition stressed by this paper. The most widely used definition of governance at the country level is provided by Kaufmann and associates at the World Bank. They define governance as "the traditions and institutions by which authority in a country is exercised" (Kaufmann et al. 2010). A huge amount of papers have demonstrated that good governance or high quality of institutions can produce better environmental policy performance (for a review, see (Dasgupta and De Cian 2016)). For example, Umemiya and his colleagues quantify the impact of governance quality on deforestation and find that an increase in governance quality tends to be associated with a decrease in deforestation rates (Umemiya et al. 2010). In addition, some studies have shown that governance quality may play a moderating role in the decentralization-environment relationship. Kim and Yoon (2017) take average of 4 indicators (government effectiveness, regulatory quality, control of corruption, and rule of law) from Worldwide Governance Indicators (WGI) to represent the capacities of government. And their regression analysis with pooled cross-national data shows that the capacities of government can significantly moderate the impact of decentralization on environmental policy performance.

Stringency of environmental regulations

Stringent environment regulations, exemplified by high standards of environmental policies and laws, are likely to improve environmental policy performance. It could urge firms to reduce waste emissions and adopt green technologies as it increases the cost of pollution-intensive production. However, many studies demonstrate that high performance of national environmental policies needs not only stringent regulatory mechanisms but also effective enforcement of these regulations (Kellenberg 2009; Manderson and Kneller 2011). For example, Kellenberg (2009) highlights, "It is not implausible that countries may commit to more stringent environmental regulation but then not allocate resources to enforce these policies". His empirical paper shows that, controlling for stringency levels, the enforcement of environmental policy is more of a deterrent to U.S. multinational activity than the level of the regulation itself. Likewise, Long et al. (2013) find that, although China has adopted stronger regulations after its accession to the WTO, its environment conditions are not guaranteed to be better. They argue that a possible reason is that governments may lack incentives to enforce these regulations under the pressure of attracting more foreign investment. It needs to be emphasized that the enforcement gap of stringent environmental regulations is partially determined by decentralization and the structural conditions, i.e. economic development and governance quality. Environmental regulations tend to be poorly enforced in those less developed countries with weak institutions. Therefore, this study takes the stringency of environmental regulations as an intermediate condition and explore how it functions together with other conditions.

In short, decentralization is a tridimensional mixture (political, fiscal and administrative) and its effects may be conditional

on the national contexts. However, it has been rarely explored in the existing literature that how tridimensional decentralization and contextual conditions jointly affect environmental policy performance. This is partially because most of previous studies are regression-based. As some scholars have maintained, traditional regression analysis is good at calculating the effect size of specific variable on the outcome, but it lacks the ability to explore the combinational effects of multiple variables (Ragin 2008; Grofman and Schneider 2008). In practice, it can be very difficult to interpret the interaction term that contains more than three variables in the regression model (Ragin 2008). It is suggested that a fuzzy set qualitative comparative analysis (fsQCA), which focuses on the set relationship between configurations of conditions and the outcome of interest, is more effective to conduct a contextual analysis (Vis 2012; Denk and Lehtinen 2013). Therefore, this study employs fsQCA to address the research gap by answering the following question: *Which combinations of decentralization and contextual conditions can produce high (or low) level of environmental policy performance?*

Data and Method

Measurement

Environmental policy performance

The outcome of interest in this research is national environmental policy performance. According to the current literature, many specific environmental outcomes, such as carbon dioxide emissions, land degradation, deforestation, SO2 and NOx emissions and water pollution, have been used to as the proxies of environmental performance. However, some researchers argue that, given the diversity and complexity of environmental governance, more comprehensive indicators should be employed so as to avoid the one-sidedness of measurement (Dasgupta and De Cian 2016). According to this recommendation, this paper adopts the Environmental Performance Index, developed by the Yale and Columbia Universities, to measure the environmental policy performance at the national level (Emerson et al. 2012). More specifically, Environmental Performance Index measures the overall environmental performance of most countries around the world in hundred-point system from both "Environmental Health" (protection of human health from environmental harm) and "Ecosystem Vitality" (protection of ecosystem) dimensions by employing twenty indicators in nine issue areas. To reduce the measurement error, this paper uses the average score of Environmental Performance Index from 2006 to 2010. Table 1 summarizes the measurement of variables and provides the descriptive statistics.

Decentralization

As mentioned in the review section, this paper aims to decompose decentralization into three dimensions: political, fiscal and administrative. There are various indicators being adopted to measure each dimension of decentralization in the existing literature (Schneider 2003). For example, political decentralization is measured by whether subnational government officials, including legislatures and executives, are locally elected, fiscal decentralization is measured by considering subnational share in the total financial expenditures or revenues of general government, and administrative decentralization is measured by calculating the sub-national government employment share of the total civilian government administration employment. However, by scrutinizing the existing indicators of decentralization, Ivanyna and Shah (2014) argue that researchers should improve the measurement of decentralization by making a distinction between "state" and "local" governments. For instance, they claim that the vague definition of state and local government in Government Finance Statistics provided by the International Monetary Fund may lead to inconsistencies. From this point of view, they provide a new index of decentralization that focuses on the local government empowerment from political, fiscal and administrative dimensions in each country. According to their methodology, these three dimensions of decentralization is constructed as follows (for details, please see (Ivanyna and Shah 2014)):

(1) Political decentralization index (*pdi*) is constructed by taking the average of three variables described in the following formula: $pdi = \frac{1}{3}(lg\_legel + lg\_exel + lg\_dirdem)$, where *lg_legel* and *lg_exel* measures to what extent the legislative bodies and executive heads at the local level, respectively, are elected, and *lg_dirdem* measures the degree of direct democracy provision in each country, i.e. Legislative provisions for obligatory local referenda for government behaviors in local decision-making processes.

(2) Fiscal decentralization index (*fdi*) is constructed by the following formula: $fdi = lg\_expaut^{*}(\gamma + (1-\gamma)/2^{*}(lg\_taxaut + lg\_borrow))$, where *lg_expaut* indicates the degree of local expenditure autonomy, *lg_taxaut* indicates the degree of tax autonomy and *lg_borrow* refers to the legal empowerment for local borrowing. Additionally, the character γ is a smoothing parameter.

(3) Administrative decentralization index (*adi*) is constructed by averaging the following two indicators: $adi = \frac{1}{2}(lg\_hrpol + lg\_empl)$. Here *lg_hrpol* measures to what extent local governments are able to hire, fire

Table 1 Variable measurement and descriptive statistics

Variables	Mean	SD	Min	Max	Measurement
Environmental policy performance	54.15	16.24	17.92	87.68	The average values of Environmental Performance Index (2006–2010). The index is developed by the Yale and Columbia Universities
Political decentralization	0.53	0.21	0	1	Ivanyna and Shah (2014),downloaded from http://www.economicsejournal.org/economics/journalarticles/2014–3, containing of 182 countries for mid 2000s (mostly 2005).
Fiscal decentralization	0.39	0.25	0.06	1	
Administrative decentralization	0.39	0.28	0	0.9	
Economic development	19,048.21	20,830.27	700.71	117,628.50	The average value of GDP per capita based on purchasing power parity (2000–2010). The data is provided by World bank.
Quality of governance	0.14	0.89	−1.48	1.9	The average value of the Worldwide Governance Indicators, i.e. "control of corruption", "government effectiveness","Regulatory Quality", "rule of law", "political stability and the absencce of voilence" and "voive and accountabililty" (2000–2010)
Stringency of environmental regulations	3.98	1.04	2.3	6.4	The index of stringency of environmental regulations provided by the World Economic Forum(2006–2007).

and set terms of local employment with their own policies. Ivanyna and Shah (2014) find that there are 77 countries in which the decisions about local employees have to be made at the central level. Again, *lg_empl* represents the share of local government employment in general government employment.

This paper adopts the index of tridimensional decentralization provided by Ivanyna and Shah (2014). The score of each dimension of decentralization ranges from 0 to 1 with the higher value meaning the higher level of decentralization. By using the data of 182 countries for mid 2000s (mostly 2005), they have developed a dataset and made it freely downloadable from the Internet.

Contextual conditions

National economic development (wealth) This paper employs the GDP per capita based on purchasing power parity (PPP) to measure the level of economic development or the degree of wealth in each country. By converting gross domestic product to international dollars using purchasing power parity rates, the values of PPP GDP are comparable among the countries because an international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. Data are in current international dollars based on the 2011 International Comparisons Program round.

Quality of governance The quality of governance at the nation level is measured by calculating the average values of the Worldwide Governance Indicators (WGI). To be specific, the quality of governance includes three main areas, and for each of them, two indicators are constructed: (1) the process by which governments are selected, monitored and replaced, measured by two indicators, i.e. Voice and Accountability and Political Stability and Absence of Violence/Terrorism; (2) the capacity of the government to effectively formulate and implement sound policies, measured by two indicators, i.e. Government Effectiveness and Regulatory Quality; (3) the respect of citizens and the state for the institutions that govern economic and social interactions among them, measured by two indicators, i.e. Rule of Law and Control of Corruption. The values of these indicators are range from −2.5 to 2.5, with higher score representing better governance. Since its development in 1996, WGI have been widely used to measure the quality of governance in empirical social science research.

Stringency of environmental regulations To measure this intermediate condition, this study employs the index of stringency of environmental regulations provided by the World Economic Forum. To be specific, the stringency of environmental regulations in a country is measured by asking business executives the following question: "How would you assess the stringency of your country's environmental regulations?" This index is weighted average of two periods and takes a value between 1 and 7 with higher value representing more stringent regulation. We choose this perceived stringency index for two reasons: one is its wide coverage (more than 130 countries); the other one is that it has been widely used in empirical research.

Table 2 provides the correlation matrix of variables. It indicates that all causal conditions are positively and significantly correlated with the outcome, i.e. environmental policy performance. However, as Table 2 shows, the three dimensions of decentralization are not highly correlated. It may be surprising but not implausible. The central governments need to hold some power and resources to govern the country, so it may implement decentralization in one dimension but keep centralization in the other. In addition, national economic

Table 2 Correlation matrix of variables

Number	Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1)	Environmental policy performance						
(2)	Political decentralization	0.39***					
(3)	Fiscal decentralization	0.59***	0.46***				
(4)	Administrative decentralization	0.47***	0.42***	0.68***			
(5)	Economic development	0.69***	0.14	0.37***	0.14		
(6)	Quality of governance	0.81***	0.32***	0.57***	0.39***	0.67***	
(7)	Stringency of environmental regulations	0.76***	0.37***	0.63***	0.46***	0.65***	0.85***

Note: ***$P < 0.01$

development is insignificantly correlated with political and administrative decentralization, which impels us to do more research on their relationship.

Analytical strategy

Multiple regression analysis (MRA)

MRA is a widely used statistical approach to explore how multiple factors affect the outcome of interest. Formally, it is usually written as an additive model: $y = \alpha + \beta_1 x_1 + \beta_2 x_2 +$. MRA assumes that determinants add up to produce the outcome. With such an additive logic, it allows us to reveal the net effect of each independent variable on the dependent variable by controlling the others (Ragin 2008). However, many scholars have claimed that MRA may produce misleading results as it tends to ignore the causal complexity. In fact, the presence of outcome is usually the result of the combinational effect of conditions with complex interaction. And this problem will be aggravated when more variables are included in the MRA model because multicollinearity may make the *p* value unreliable (Woodside 2013).

Fuzzy set qualitative comparative analysis (fsQCA)

Formally invented by Charles Ragin in 1980s, QCA has been increasingly used by researchers in variety of academic fields. Different from traditional regression analysis that relies on the statistical correlation, QCA is a set-theoretic method that uses Boolean logic as its inferential technique (Ragin 2008). Schneider and Wagemann (2012:3) summarize the basic features of set-theoretic methods as follows: "first, they work with membership scores of cases in sets; second, they perceive relations between social phenomena as set relations; third, these set relations are interpreted in terms of sufficiency and necessity". Specifically, a condition that is a subset of the outcome is logically sufficient for the outcome because its presence always produces the outcome. Conversely, a condition that is a superset of the outcome is logically necessary for the outcome because the outcome cannot exist without its presence. Based on the logic of necessity and sufficiency, QCA aims to establish logical connection between causal conditions (or their combinations) and the outcome, rather than to isolate the net effect of particular variable.

There are three key ideals that make QCA able to embrace causal complexity (Ragin 2008; Schneider and Eggert 2014; Misangyi et al. 2016). The first is *causal asymmetry*, which emphasizes that the cause of the negative outcome is not seen as the inverse of the cause of the positive outcome. For example, low income may cause unhappiness, but high income does not guarantee happiness. The second is *conjunctural causation*. It is not uncommon that the combinations of conditions, rather than just single condition, lead to the presence of outcome. For example, it is plausible to say that happiness is produced by a combination of conditions, including income level, subjective equality, health status, and so on. The third is *equifinality*, which refers to the multiple pathways to the same outcome of interest, with the same logic as the saying: "all road leads to Rome". Again, we may find many pathways that can achieve happiness with or without high income. According to our research question, QCA is an appropriate tool to examine the relationship between decentralization, national contextual factors and environmental policy performance.

Traditionally, QCA is based on the crisp set relations in which each case is assigned one of two possible membership scores in each set (1 refers to membership in the set, while 0 refers to non-membership in the set). Ragin (2008) argues that the above dichotomous calibration is likely to oversimplify the social reality. For example, while some countries can be clearly classified into "decentralized" or "centralized", there is a broad range of in-between cases: they are not fully in or out of the set of decentralized countries. To allow partial membership, Ragin (2008) develops fuzzy set QCA to permit membership scores in the interval between 0 and 1. With the use of membership scores, fsQCA provides more accurate reflection of social

phenomena. As such, it is used with increasing frequency especially in political science. This paper employs fsQCA as the primary analytical tool.

Basic steps to apply fsQCA

Before applying fsQCA to this study, it is useful to specify two parameters of fit: consistency and coverage. Consistency assesses the degree to which the cases sharing a condition (or combination of conditions) agree in displaying the outcome, while coverage evaluates the degree to which a condition (or combination of conditions) accounts for instances of the outcome. To facilitate understanding of these parameters, Woodside (2013) suggests that the former functions as the *p* values in statistical analysis, while the latter can be grasped by analogizing it to the R square in regression analysis.

The basic steps of fsQCA are summarized as follows:

1. Calibrate raw data into fuzzy set relations. Calibration is a key step to perform fsQCA after data collection. The goal of calibration is to rescale the raw data into set membership scores ranging from 0 to 1. For example, a set membership score 0.9 can be expressed as "mostly in the set", while 0.1 means "mostly out of the set". Technically, this study employs the direct calibration method (Ragin 2008), which specifies the three thresholds (fully membership, cross-over point and full non-membership) as anchors to perform the calibration of fuzzy sets. Since this study is explorative and deals with 118 countries in a varying setting without definitive standards for areas of measurement, the threshold values are determined by the exiting distribution and knowledge of the cases. More specifically, the full membership threshold is set at 20th percentile, the full non-membership threshold is set at 80th percentile, and the crossover point with maximum ambiguity is set at 50th percentile. The threshold values for calibration is shown in Tables 3 and the results of calibration can be seen in Appendix A.
2. Testing the necessity of single condition for the outcome. Ragin (2008) suggests that the necessity of single condition should be tested before exploring the sufficient configurations of conditions for the outcome. If a condition is considered as necessary factor for the presence or absence of outcome, we can exclude it from the following sufficiency analysis as it has to be present to make the outcome possible. To test the necessity of conditions, we need to specify a threshold value of consistency. Following Ragin (2008)'s recommendation, this study uses 0.9 as threshold so as to enhance the robustness of fsQCA results. As Table 4 shows, a test of necessity demonstrates that no single condition is necessary for achieving high or low level of environmental policy performance.
3. Building the truth table. As a configurational analysis technique, fsQCA focuses on the relationship between combinations of conditions and the outcome. A truth table is constructed to display the combinations of conditions and their related outcome. Mathematically, there are 2^k logically possible combinations of conditions where k refers to the number of conditions. And, at the same time, two threshold values need to be specified. One is the threshold of consistency. As mentioned above, consistency represents to what degree a causal combination is a subset of the outcome. This study sets the threshold of consistency at 0.9, indicating that combinations with scores below 0.9 are considered as substantial inconsistency and then coded with 0, while combinations with consistency scores at or above 0.9 are coded with 1. And the other is the threshold of frequency, which refers to the minimum amount of cases that exceed the crossover point of 0.5 membership in each combination. This study sets the threshold of frequency at 2 as the sample is moderately sized (118 countries).

(4) Minimizing configurations by using Boolean algebra logic. After constructing the truth table, the next step is to minimize these configurations by eliminating the irrelevant conditions with the Boolean algebra logic. As Ragin(2008) has summarized, the core logic of Boolean minimization is that, if two expressions differ in only one condition but produce the same outcome, then the condition that differentiates the two expressions may be regarded as irrelevant and can be excluded. By excluding those irrelevant conditions in the configurations, the expressions become more compressed and simpler to interpret. For example, there is a causal expression with

Table 3 The thresholds values for calibration

Condition-set	Abbreviation	Fully out	Crossover point	Fully in
High environmental performance	HEP	39.36	52.58	72.09
Politically decentrealized	PD	0.33	0.54	0.75
Fiscally decentralized	FD	0.16	0.37	0.62
Administratively decentralized	AD	0.05	0.35	0.67
High GDP per capita (Wealthy)	WE	3247.69	11,575.82	36,077.72
Good governance	GG	−0.57	−0.08	1.08
Stringent environmental regulations	SR	3.1	3.7	4.96

Table 4 The results of necessity tests

	HEP		LEP	
Conditions	Consistency	Coverage	Consistency	Coverage
PD	0.69	0.67	0.48	0.46
~PD	0.44	0.47	0.65	0.67
FD	0.73	0.72	0.43	0.42
~FD	0.41	0.42	0.71	0.72
AD	0.70	0.68	0.46	0.44
~AD	0.43	0.44	0.67	0.68
WE	0.88	0.88	0.34	0.33
~WE	0.33	0.34	0.87	0.87
GG	0.83	0.83	0.35	0.34
~GG	0.34	0.35	0.83	0.83
SR	0.81	0.79	0.38	0.37
~SR	0.35	0.37	0.79	0.80

Note: HEP (LEP) = high (low) level of environmental policy performance, PD = politically decentralized, FD = fiscally decentralized, AD = administratively decentralized, WE = wealthy countries, GG = good governnance, SR = stringent environmental regulation; "~" refers to the negation of conditions

Boolean operators, $A^*B + A^*{\sim}B \rightarrow C$. In this formula, an asterisk (*) represents a logical AND, a plus (+) a logical OR, and a tilde (~) a logical NOT. An arrow to the right (→) can be understood as "is/are sufficient for". The above formula can be interpreted as that A is sufficient for outcome C regardless of whether condition B is present or not. Therefore, B is an irrelevant condition that can be excluded.

Additionally, Boolean minimization needs to deal with the logical reminders, i.e. configurations not reaching the minimum number of cases (Ragin 2008). The complex solution does not allow any logical remainders to be included into minimization, the parsimonious solution permits the use of any remainder that will yield simpler (or fewer) recipes, while the intermediate solution only uses the remainders that survive counterfactual analysis based on theoretical and substantive knowledge. Following Ragin (2008), this study employs the intermediate solution as it is better for interpretation, without being too complex or simple.

Results

Results of MRA

This study uses MRA to assess the net effects of independent variables on environmental policy performance. A number of regression diagnostics are conducted, including the tests of skewness, kurtosis, link functions and heteroscedasticity. The regression diagnostics show the model in this study satisfies the linear regression hypothesis. Table 5 presents the results of MRA. Although all dimensions of decentralization (political, fiscal and administrative) tend to exert positive impact on the environmental policy performance, only administrative decentralization is significant at 95% confidence level. As for the contextual conditions, the stringency of environmental regulations does not show a significant effect on the environmental policy performance, while the structural contextual factors, i.e. the quality of governance and the level of economic development, are significantly and positively associated with the environmental policy performance. In terms of standardized coefficients, the most predictive factor of environmental policy performance is national level of economic development. Its standardized coefficient is 0.58, much higher than that of government quality (0.19) and that of administrative decentralization (0.14). In addition, the coefficient of

Table 5 The results of MRA

	Environmental policy performance							
	B	CI			std. Beta	CI		*p*
(Intercept)	−30.2	−47.01	–	−13.39				<.001
Political decentralization	5.39	−1.43	–	12.21	0.07	−0.02	– 0.16	0.12
Fiscal decentralization	5.39	−6.52	–	9.72	0.02	−0.10	– 0.15	0.697
Administrative decentralization	8.36	2.17	–	14.55	0.14	0.04	– 0.25	0.009
National economic development	7.74	6.07	–	9.40	0.58	0.46	– 0.70	<.001
Quality of governance	3.52	0.42	–	6.62	0.19	0.02	– 0.6	0.026
Stringency of environmental regulations	1.42	−1.05	–	3.90	0.09	−0.07	– 0.25	0.256
Observations					118			
R^2/adj. R^2					.830/.821			
F-statistics					90.496***			

Table 6 The truth table for high environmental policy performance

Configurations	PD	FD	AD	WE	GQ	SR	OUT	*n*	Consistency	Cases
32	0	1	1	1	1	1	1	4	0.99	CHL,LVA,MYS,ESP,AUS,AUT,BEL,BRA,CAN,HRV,CZE,DNK,FIN
64	1	1	1	1	1	1	1	24	0.98	FRA,DEU,HUN,ISL,JPN,LTU,NZL,NOR,POL,PRT,SGP,SVN,CHE, GBR,USA
40	1	0	0	1	1	1	1	5	0.94	CYP,GRC,IRL,ISR,MLT
16	0	0	1	1	1	1	1	2	0.93	EST,NLD
5	0	0	0	1	0	0	0	2	0.85	DZA,SAU
8	0	0	0	1	1	1	0	4	0.84	BRB,MUS,OMN,QAT
7	0	0	0	1	1	0	0	4	0.83	KWT,PAN,SUR,TTO
10	0	0	1	0	0	1	0	2	0.71	LKA,UZB
57	1	1	1	0	0	0	0	4	0.61	BOL,BIH,ECU,PRY
25	0	1	1	0	0	0	0	5	0.60	ALB,ARM,AZE,CHN,IDN
9	0	0	1	0	0	0	0	4	0.55	ETH,MDA,MAR,SEN
3	0	0	0	0	1	0	0	2	0.55	JAM,MNG
41	1	0	1	0	0	0	0	3	0.51	UGA,UKR,VNM
33	1	0	0	0	0	0	0	4	0.43	DOM,NPL,NIC,NGA
17	0	1	0	0	0	0	0	3	0.43	SLV,LSO,MOZ
1	0	0	0	0	0	0	0	13	0.35	BFA,BDI,KHM,CMR,TCD,EGY,GTM,GUY,MLI,MRT,TJK,ZMB,ZWE

determination, R square (adjusted R square), is 0.830 (0.821), indicating that this regression model has a good fit for the raw data. As such, according to the MRA results, we may conclude that, on the one hand, administrative decentralization is more important than political and fiscal decentralization to improve environmental policy performance, but on the other hand, advanced economy and good governance, rather than decentralization, are the major determinants of environmental policy performance.

Table 7 Pathways to high environmental policy performance

	Pathways		
Conditions	H1	H2	H3
Politically decentralized		⊗	●
Fiscally decentralized	●		⊗
Administratively decentralized	●	●	⊗
High GDP per capita (Wealthy)	●	●	●
Good governance	●	●	●
Stringent environmental regulations	●	●	●
Consistency	0.970	0.959	0.938
Raw coverage	0.504	0.197	0.126
Unique coverage	0.317	0.026	0.063
Solution consistency	0.967		
Solution coverage	0.593		

Note: ● means the presence of this condition, while ⊗ means the absence of this condition. Pathways

Results of fsQCA

Decentralization, contextual conditions and high environmental policy performance

Different from regression analysis, QCA emphasizes causal asymmetry between configurations of conditions and the outcome. As such, this study starts by examining the configurational conditions for high environmental policy performance. Table 6 shows the truth table that display all observed configurations and their related outcomes. There are 16 out of 64 (2^6=64) configurations with at least 2 cases observed. Configurations with consistency higher than 0.9 (the threshold value) are coded as 1 (otherwise coded as 0) in the "OUT" column, indicating that they can consistently produce the presence of the outcome. Therefore, our sample data supports that there are 4 configurations of conditions (above the dash line) are associated with the high environmental policy performance.

Based on the truth table, fsQCA adopts the Boolean algebra logic to minimize the configurations that produce high environmental policy performance. For example, the first and second rows differ in only one condition, i.e. PD, but they produce the same outcome, therefore PD is an irrelevant condition and then excluded from these two configurations. Following previous research, this study employs the intermediate solution and summarizes its major results in the Table 7.

As can be seen from Table 7, there are three pathways that can lead to high environmental policy performance. The model consistency is high (0.967) and the solution coverage is

0.593, which indicating that this model covers nearly 60% of the countries with high environmental policy performance. Pathway H1 is the most consistent path and has the highest raw and unique coverage, which means it makes the largest contribution to the model solution. More specifically, as is shown in pathway H1, high environmental policy performance appears most often when a country is fiscally and administratively decentralized and all contextual conditions (advanced economy, good governance and stringent environmental regulation) are present. In addition, Pathway H2 and H3 can also lead to high environmental policy performance in a country. Like Pathway H1, both of them require all contextual conditions to be present. Pathway 2 further requires a combination of political centralization and administrative decentralization, while Pathway H3 further requires that a country is politically decentralized but fiscally and administratively centralized. The coverage scores of Pathway H2 and H3 are much lower than Pathway H1, representing that they are less empirically supported by the sample data in this study.

Decentralization, contextual conditions and low environmental policy performance

This study takes a step further to analyze what combinations of decentralization and contextual conditions may lower the environmental policy performance. Table 8 is the truth table for low environmental policy performance. A quick glance of the table reveals that 16 configurations can be observed in the empirical data and 9 of them (above the dash line) meet the threshold values of consistency (0.9) and frequency (at least 2 cases). The configuration 1 in the fourth row, which represents that the absence of all conditions is associated with low environmental policy performance, is supported by the largest number of cases. And, the absence of advanced economy is the constitutive part of all 9 configurations that produce low environmental policy performance. To get more condensed solutions, this study proceeds with the Boolean minimization.

The intermediate solution the results from Boolean minimization has been summarized in Table 9. The model consistency is high (0.909) and the solution coverage is also relatively high (0.678), indicating that nearly 70% of cases with low environmental policy performance are covered by this model. There are 5 pathways that tend to decease environmental performance. The Pathway L1, L2, and L3 share some combination of contextual conditions (low wealth, poor governance and lax environmental regulation) but differ in the dimension of decentralization: Pathway L1 further requires fiscal centralization, Pathway L2 further requires political centralization, while Pathway L3 further requires administrative decentralization. Pathway L4 shows that in the configuration that combines centralization (political, fiscal, and administrative), low wealth and lax environmental regulation, the quality of governance tends to be ineffective to improve environmental performance. The last pathway, L5, is constituted by two parts: an unfavorable structural context (low wealth and poor governance) and a complex composition of decentralization (politically and fiscally centralized but administratively decentralized). It means that the

Table 8 The truth table for low environmental policy performance

Configurations	PD	FD	AD	WE	GQ	SR	OUT	n	Consistency	Cases
17	0	1	0	0	0	0	1	3	1.00	SLV,LSO,MOZ
9	0	0	1	0	0	0	1	4	0.98	ETH,MDA,MAR,SEN
41	1	0	1	0	0	0	1	3	0.98	UGA,UKR,VNM
1	0	0	0	0	0	0	1	13	0.97	BFA,BDI,KHM,CMR,TCD,EGY,GTM,GUY,MLI,MRT,TJK,ZMB,ZWE
3	0	0	0	0	1	0	1	2	0.96	JAM,MNG
33	1	0	0	0	0	0	1	4	0.95	DOM,NPL,NIC,NGA
10	0	0	1	0	0	1	1	2	0.95	LKA,UZB
57	1	1	1	0	0	0	1	4	0.93	BOL,BIH,ECU,PRY
25	0	1	1	0	0	0	1	5	0.91	ALB,ARM,AZE,CHN,IDN
5	0	0	0	1	0	0	0	2	0.90	DZA,SAU
7	0	0	0	1	1	0	0	4	0.88	KWT,PAN,SUR,TTO
8	0	0	0	1	1	1	0	4	0.79	BRB,MUS,OMN,QAT
16	0	0	1	1	1	1	0	2	0.63	EST,NLD
40	1	0	0	1	1	1	0	5	0.55	CYP,GRC,IRL,ISR,MLT
32	0	1	1	1	1	1	0	4	0.34	CHL,LVA,MYS,ESP
64	1	1	1	1	1	1	0	24	0.20	AUS,AUT,BEL,BRA,CAN,HRV,CZE,DNK,FIN,FRA,DEU,HUN,ISL,JPN,LTU,NZL,NOR,POL,PRT,SGP,SVN,CHE,GBR,USA

Table 9 Pathways to low environmental policy performance

	Pathways				
Conditions	L1	L2	L3	L4	L5
Politically decentralized		⊚		⊚	⊚
Fiscally decentralized	⊚			⊚	⊚
Administratively decentralized			●	⊚	●
High GDP per capita (Wealthy)	⊚	⊚	⊚	⊚	⊚
Good governance	⊚	⊚	⊚		⊚
Stringent environmental regulations	⊚	⊚	⊚	⊚	
Consistency	0.941	0.943	0.904	0.962	0.957
Raw coverage	0.526	0.477	0.360	0.373	0.214
Unique coverage	0.052	0.028	0.042	0.020	0.015
Solution consistency			0.909		
Solution coverage			0.678		

Note: ● means the presence of this condition, while ⊚ means the absence of this condition

stringency of environmental regulations tends to be irrelevant if a country meets this configuration of conditions. In terms of coverage, the Pathway L1 has the largest score (raw coverage: 0.526; unique coverage: 0.052), indicating that it is of the most empirical importance in this model. And it is interesting to find that, although MRA shows that administrative decentralization is significantly and positively associated with environmental policy performance, its combination with specific context tends to produce negative outcome.

Discussion and policy implications

There are at least four interesting findings that are worth further discussing. First, this study shows that the political, fiscal and administrative dimensions of decentralization differ in their impacts on the environmental policy performance. For example, the regression analysis with 118 countries reveals that only administrative decentralization significantly and positively affects environmental policy performance. And fsQCA also finds that each dimension of decentralization can be integrated into different configurations that lead to different performance of national environmental policy. As such, researchers should decompose decentralization into different dimensions and analyze them simultaneously because a general conceptualization or just focusing on one dimension of it may result in an incomplete understanding of its multifaceted functions.

Second, there are multiple pathways to high or low environmental policy performance, with specific configurations of decentralization in the specific context. As mentioned in the method section, a key ideal of fsQCA is equifinality, suggesting that different configurations may lead to the same outcome. This study, based on the data of 118 countries, shows that there are 3 pathways to high environmental policy performance while 5 pathways to the opposite outcome. Regarding these pathways, we further find that: (1) A favorable context, i.e., advanced economy, good governance and stringent environmental regulations, is the crucial to achieve high environmental policy performance. Table 7 shows that all pathways that produce high environmental policy performance require the favorable context, and Table 9 shows the absence of the favorable context become the essential part of 3 (out of 5) pathways that result in low performance of environmental policy. (2) High environmental policy performance appears most often when a country is not only fiscally and administratively decentralized but also has the favorable context as mentioned above (Pathway H1). In other words, in the situation that these five conditions are present, political decentralization tends to be an irrelevant condition to achieve high environmental policy performance. For example, in our sample, 29 countries meet the configurational conditions in Pathway H1. More specifically, 28 countries among them(except Brazil) achieve high environmental policy performance (membership score > 0.5), while 4 out of 28 countries have low membership in the set of political decentralization, i.e. Malaysia, Chile, Latvia and Spain. (3) As Pathway L1 shows, low environmental policy performance appears most often when a country is fiscally centralized and its context is unfavorable, regardless of whether the other dimensions of decentralization is present or not. For example, Uganda, a less developed, poorly governed country with lax regulation of environmental polluters, is fully in the set of low environmental policy performance. In terms of decentralization, it is fiscally centralized but politically and administratively decentralized.

Third, it may produce completely different outcome when decentralization is implemented in the different contexts. For example, Pathway H1, H2, L3 and L5 all include administrative decentralization, their outcome, however, are quite different: the former two pathways lead to high environmental policy performance, while the latter two result in the opposite outcome. More specifically, the merits of administrative decentralization can only be seen in the favorable context as mentioned above with the presence of fiscal decentralization or political centralization simultaneously. Each condition in these configurations works as a INUS cause, i.e., an insufficient but necessary part of a condition that is unnecessary but sufficient for the outcome. Without the support of the favorable context, administrative decentralization tends to be the INUS cause of low environmental policy performance, just as the cases of Vietnam, China, Ukraine, Indonesia etc. Therefore, it provides us some restricted schemes to appropriately implement administrative decentralization.

Fourth, fsQCA is complementary to MRA in exploring the determinants of environmental policy performance. MRA calculates the net effect of each condition on environmental policy performance and identifies which one has the biggest effect size, while fsQCA reveals specific configurations of conditions that are usually sufficient for high or low environmental policy

performance. In this study, MRA shows that national level of economic development is the most predictive factor for environmental policy performance, while fsQCA highlights that the presence (absence) of advanced economy is the INUS cause of high (low) environmental policy performance. Again, MRA finds only administrative decentralization exerts significant and positive impact on environmental policy performance, while fsQCA reveals that the role of administrative decentralization is contingent upon the other dimensions of decentralization and what the national context is. Therefore, as Vis(2012) has suggested, it is beneficial to employ both MRA and fsQCA to explore the complexity of social phenomena.

This study offers some valuable implications for the policy makers. First, much more attention should be paid to the fit between decentralization and national context. High environmental policy performance occurs only when decentralization is implemented in the suitable context. This study suggests that a favorable context, i.e. advanced economy, good governance and stringent environmental regulation, is the prerequisite for decentralization to work effectively. Decentralization without that favorable context may cause the opposite outcome. Second, there are three pathways that can be employed to enhance the performance of environmental policy. With the favorable context mentioned above, policy makers can take the following configurations of decentralization: (1) fiscally and administratively decentralized, (2) administratively decentralized but politically centralized and (3) political decentralized but fiscally and administratively centralized. In other words, the absence of fiscal and administrative decentralization can be compensated by the presence of political decentralization in those countries with the favorable context. Likewise, if a country has the favorable context and is also administratively decentralized, fiscal decentralization may play an equivalent role as political centralization. Third, the most common pathway to high environmental policy performance is promoting fiscal and administrative decentralization in the favorable context mentioned above, while the most common pathway to low environmental policy performance is becoming fiscal centralized but without the favorable context mentioned above. Therefore, in terms of decentralization, policy makers should focus far more on fiscal and administrative decentralization, rather than political decentralization, because the experiences of most countries show that political decentralization is usually irrelevant for environmental policy performance.

Conclusion

This study examines the relationship between decentralization, national context and environmental policy performance with the cross-sectional data from 118 countries. Beyond a conflated conceptualization of decentralization, this study decomposes it into three dimensions (political, fiscal and administrative). In terms of national context, three conditions, i.e. economic development, governance quality and stringency of environmental regulations, are included. By employing both MRA and fsQCA, this study not only identifies the net effect of each condition on environmental policy performance but also reveals which combination of these conditions can lead to high (or low) environmental policy performance.

A summary of major results is as follows. First, the political, fiscal and administrative dimensions of decentralization differ in their net effects on the environmental policy performance. Second, there are multiple pathways, constituted by specific configurations of decentralization and context conditions, to high (or low) environmental policy performance. Third, the most common way to high environmental policy performance is promoting fiscal and administrative decentralization in the favorable context (advanced economy, good governance and stringent environmental regulation). Political decentralization, as this configuration suggests, seems to be irrelevant to the outcome. Fourth, low environmental policy performance appears most often when a country is fiscally centralized and its context is unfavorable, regardless of whether the other dimensions of decentralization is present or not. These findings provide us with a more contextualized understanding of the role of decentralization in enhancing environmental policy performance.

Some limitations in this study need to be emphasized. The first is concerned with the causal interpretation of fsQCA results. The fsQCA users should bear in mind that the aim of this method is not to definitely prove causation as confounding is always a possibility in observational studies, but to find out what kinds of subset relationships between conditions (or their combinations) and outcome are, to what degree, supported by the empirical data. The interpretation of necessity or sufficiency is just what the data, on the basis of the laws of Boolean algebra, tell us functionally. Thus, one should not make strong claims about causality based on this set-theoretic method. Second, this study is exploratory in nature and only reveals the consistent relationship between different configurations of conditions and the outcome of interest. It lacks a detailed explanation of the micro processes through which these configurations produce specific environmental policy performance. To make up these shortages, further studies should conduct more field investigation and then perform within-case and cross-case study in much detail.

Funding This work was supported by China National Social Science Foundation [No. 18CZZ023].

Compliance with ethical standards

Conflict of interest None.

Appendix A. The fuzzy set scores for all countries in the sample

Countries	PD	FD	AD	WE	GQ	SR	HEP	LEP
Albania	0	1	1	0.3	0.23	0	0.6	0.4
Algeria	0	0.32	0.18	0.53	0	0.37	0.34	0.66
Armenia	0	0.74	1	0.16	0.34	0	0.74	0.26
Australia	0.83	1	0.81	1	1	1	1	0
Austria	1	1	1	1	1	1	1	0
Azerbaijan	0.47	0.64	1	0.46	0	0.17	0.61	0.39
Bahrain	0	0	0.14	1	0.66	0.5	0.46	0.54
Bangladesh	0	0.7	0.5	0	0	0	0	1
Barbados	0	0	0	0.66	1	0.55	0.2	0.8
Belgium	0.83	1	1	1	1	1	0.89	0.11
Benin	0	0.28	0	0	0.41	0.5	0	1
Bolivia	0.84	0.59	0.73	0.11	0.1	0.26	0.36	0.64
Bosnia and Herzegovina	1	1	0.97	0.34	0.21	0	0.19	0.81
Botswana	0	0	0.53	0.51	0.9	0.37	0.24	0.76
Brazil	1	1	1	0.57	0.59	0.8	0.44	0.56
Bulgaria	1	0.38	1	0.59	0.64	0.17	0.83	0.17
Burkina Faso	0.47	0	0.12	0	0.33	0.37	0.01	0.99
Burundi	0	0	0	0	0	0	0	1
Cambodia	0	0.17	0.35	0	0	0	0	1
Cameroon	0.28	0	0	0	0	0	0	1
Canada	1	1	1	1	1	1	1	0
Chad	0.17	0	0	0	0	0	0	1
Chile	0.47	0.96	0.89	0.73	1	0.86	0.94	0.06
China	0	0.96	1	0.19	0.04	0.26	0.1	0.9
Colombia	0.83	0.9	0.79	0.44	0.09	0.7	0.37	0.63
Costa Rica	0	0.8	0	0.47	0.8	0.91	0.71	0.29
Croatia	0.66	0.64	0.87	0.79	0.71	0.73	0.8	0.2
Cyprus	1	0.25	0	0.97	1	0.55	0.86	0.14
Czech Republic	0.66	1	0.61	0.83	0.93	1	1	0
Denmark	0.66	1	1	1	1	1	1	0
Dominican Republic	0.66	0	0	0.41	0.26	0.26	0.59	0.41
Ecuador	0.83	0.69	0.67	0.36	0	0	0.67	0.33
Egypt	0	0	0.35	0.37	0.13	0.26	0.79	0.21
El Salvador	0.28	0.57	0	0.29	0.46	0.37	0.09	0.91
Estonia	0.28	0.28	0.83	0.8	0.97	0.95	1	0
Ethiopia	0.47	0.47	0.61	0	0	0	0	1
Finland	0.83	1	1	1	1	1	1	0
France	0.66	1	0.99	1	1	1	0.99	0.01
Gambia	0.83	0	0.37	0	0.2	0.65	0	1
Georgia	0.28	1	1	0.1	0.17	0.65	0.21	0.79

Germany	1	1	0.91	1	1	1	1	0
Greece	1	0.41	0.17	0.93	0.87	0.7	1	0
Guatemala	0	0.12	0.37	0.23	0	0.26	0.26	0.74
Guyana	0.47	0	0.23	0.14	0.24	0	0	1
Honduras	0.28	0.36	0.4	0.07	0	0.5	0.29	0.71
Hungary	1	1	1	0.81	0.94	0.95	0.97	0.03
Iceland	1	1	0.97	1	1	1	1	0
India	0.83	0.77	0.5	0.01	0.4	0.8	0	1
Indonesia	0.49	0.84	0.56	0.26	0	0	0.16	0.84
Ireland	0.66	0.34	0.4	1	1	1	1	0
Israel	0.83	0.17	0.12	0.91	0.79	0.91	0.87	0.13
Italy	1	0.8	0.5	1	0.84	0.95	1	0
Jamaica	0.47	0.25	0	0.39	0.56	0.28	0.7	0.3
Japan	1	1	0.81	0.99	1	1	1	0
Jordan	0	0	0.67	0.43	0.57	0.65	0.64	0.36
Kazakhstan	0	0.5	0.27	0.7	0	0.17	0.39	0.61
Kenya	0	0.47	0.2	0	0	0.5	0	1
Kuwait	0	0	0	1	0.67	0.26	0.49	0.51
Latvia	0.47	0.87	1	0.71	0.81	0.8	0.81	0.19
Lesotho	0	0.51	0	0	0.44	0	0	1
Libya	0.83	0	0	0.84	0	0	0.07	0.93
Lithuania	1	0.57	1	0.76	0.86	0.86	0.76	0.24
Luxembourg	0.66	1	0.5	1	1	1	1	0
Madagascar	1	0	0.5	0	0.36	0.5	0	1
Malaysia	0	0.64	0.73	0.77	0.74	1	0.77	0.23
Mali	0.29	0	0	0	0.39	0.39	0	1
Malta	0.66	0	0	0.87	1	0.55	0.93	0.07
Mauritania	0	0	0	0	0.06	0	0	1
Mauritius	0.47	0.08	0	0.6	0.91	0.7	0.66	0.34
Mexico	1	0.66	0.35	0.67	0.5	0.65	0.57	0.43
Moldova	0.47	0.12	1	0	0.11	0	0.51	0.49
Mongolia	0.28	0.47	0.27	0.2	0.53	0	0.17	0.83
Morocco	0.47	0.33	0.56	0.17	0.37	0.37	0.4	0.6
Mozambique	0	0.64	0	0	0.31	0.17	0	1
Namibia	0.66	0	0.35	0.31	0.69	0.5	0.04	0.96
Nepal	1	0.25	0	0	0	0	0	1
Netherlands	0.47	0.47	1	1	1	1	1	0
New Zealand	0.83	1	0.79	0.94	1	1	1	0
Nicaragua	1	0	0	0.04	0.07	0	0.33	0.67
Nigeria	0.83	0.32	0.27	0.09	0	0	0	1
Norway	0.66	1	1	1	1	1	1	0
Oman	0	0	0	1	0.7	0.97	0.23	0.77
Pakistan	0.51	0.84	0.5	0.06	0	0.5	0	1
Panama	0	0.17	0	0.54	0.61	0.37	0.63	0.37
Paraguay	0.83	0.57	0.79	0.21	0	0	0	1
Peru	1	0.5	0.97	0.33	0.27	0.37	0.13	0.87

Philippines	1	0.84	0.91	0.13	0.14	0.5	0.14	0.86
Poland	0.66	1	1	0.74	0.83	0.73	0.96	0.04
Portugal	1	0.93	0.87	0.9	1	1	1	0
Qatar	0	0	0	1	0.77	1	0.84	0.16
Romania	0.66	0.67	0.61	0.63	0.6	0.39	0.31	0.69
Saudi Arabia	0	0	0	1	0.3	0	0.9	0.1
Senegal	0.28	0.32	0.73	0	0.43	0	0.03	0.97
Singapore	0.83	1	0.97	1	1	1	1	0
Slovenia	1	0.57	1	0.89	0.96	1	1	0
South Africa	0.28	0.97	0.57	0.49	0.73	0.86	0.41	0.59
Spain	0.47	1	0.53	0.96	0.99	0.82	1	0
Sri Lanka	0.3	0.25	0.87	0.24	0.29	0.65	0.5	0.5
Suriname	0	0	0	0.56	0.51	0	0.53	0.47
Sweden	0.5	1	1	1	1	1	1	0
Switzerland	1	1	1	1	1	1	1	0
Tajikistan	0	0.25	0.27	0	0	0	0	1
Tanzania	0.47	0.18	0.42	0	0.19	0.5	0	1
Thailand	0.66	0.74	0.5	0.5	0.49	0.8	0.54	0.46
Trinidad and Tobago	0.47	0	0	0.86	0.63	0.17	0.47	0.53
Tunisia	0.47	0.41	0.35	0.4	0.54	1	0.73	0.27
Turkey	0.66	0.74	0.4	0.64	0.47	0.65	0.56	0.44
Uganda	1	0.17	0.63	0	0	0.28	0	1
Ukraine	0.67	0.42	1	0.27	0.01	0	0.27	0.73
United Arab Emirates	0.28	0.93	0.29	1	0.76	0.91	1	0
United Kingdom	0.83	0.86	0.69	1	1	1	1	0
United States	1	1	1	1	1	1	0.91	0.09
Uruguay	1	0.9	0.21	0.61	0.89	0.8	0.43	0.57
Uzbekistan	0.49	0.12	0.67	0	0	0.65	0.11	0.89
Venezuela	0.83	0.77	0.2	0.69	0	0.26	0.69	0.31
Vietnam	0.66	0	0.79	0.03	0.03	0	0	1
Zambia	0	0.37	0.17	0	0.16	0	0.06	0.94
Zimbabwe	0.28	0.08	0.14	0	0	0	0.3	0.7

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