Contemporary Politics, 2013
Vol. 19, No. 1, 76–93, http://dx.doi.org/10.1080/13569775.2013.773204

Routledge
Taylor & Francis Group

Comparing ecological sustainability in autocracies and democracies

Stefan Wurster*

Institute of Political Science, Ruprecht-Karls-University Heidelberg, Germany

Considering the ecological sustainability performance of different political regimes, it seems questionable whether the assumption of the general superiority of democracy can be maintained in this policy field. This paper compares the performance of democracies and autocracies (and their institutional subtypes) with regard to weak and strong ecological sustainability targets, on the one hand, while also analysing the impact of democracy and autocracy on different areas of ecological sustainability, on the other. This will be verified by quantitative analysis to measure the influence of regime type on ecological sustainability performance, as opposed to the effect of other possible explanatory factors.

Keywords: ecological sustainability; weak and strong sustainability; regime type; democracy and autocracy

1. Introduction

Although the current financial and economic crisis has pushed global environmental problems (climate change, environmental degradation, resource consumption) somewhat into the background, overcoming these problems is still one of the central tasks of the twenty-first century facing every country in the world. Consistent with that goal, participants in the first major international climate and environmental conferences (Rio 1992, Kyoto 1997) have formulated general principles of sustainable development to address these issues. All countries need to react and adapt to the symptoms of individual, competing environmental problems ('weak sustainability'). In addition, states have to initiate strategies of long-term fundamental changes in order to ensure that the environment is preserved intact for future generations ('strong sustainability').

A large number of democracies have failed to meet both general sustainability targets (Lupia and McCubbins 1998, Benn and Dunphy 2004) and targets of ecological sustainability (Barry and Wissenburg 2001, Eckersley 2004) including 'the maintenance of important environmental functions into the indefinite future' (Ekins and Simon 2001).[1] Coupled with the recent insufficient progress by the consensus-oriented and participation-based climate and environmental conferences such as Copenhagen (2009), Durban (2011) and Doha (2012), this has led to an amplification of the call for an authoritarian body to protect the environment. The way China has impressively steered a path through the global economic crisis also seems to support the claim that enlightened autocrats 'may serve their countries more effectively in times of crises' (Fliegauf and Sanga 2010, p. 4), which the ecological problems that have been mentioned would appear to be. So the question of whether an eco-dictatorship is necessary in order to overcome presence bias in democracies and to achieve a quick reversal in fundamental attitudes towards greater sustainability, which has already been addressed in the report by Meadows

*Stefan Wurster is a political scientist at the Ruprecht-Karls-University Heidelberg who teaches and is doing research on comparative public policy, sustainable development and the policy in the Federal Republic of Germany. Email: stefan.wurster@ipw.uni-heidelberg.de

et al. (1972), is still a controversial topic of discussion. 'The underlying notion here is that competitive or liberal–pluralist democracy is not adequate to the type of socio-economic transition deemed necessary to rectify major environmental and ecological challenges' (Lafferty 2004, p. 2).

In order to assess this question beyond the theoretical considerations of the pros and cons of democratic versus autocratic environmental rule, it is necessary to empirically test whether and under which circumstances autocracies or different subtypes of authoritarianism actually perform better than democracies in the area of environmental protection.

This article contributes to the links between the discourses on regime type and ecological sustainability by answering the following questions:

- What results have been achieved by democracies and autocracies with regard to their weak or strong ecological sustainability performance? Can patterns of systematic performance be detected beyond the respective regime types with respect to their institutional variations (regime subtypes)?
- What role does regime type actually play in a country's ecological sustainability performance relative to other factors?

The following section presents the concepts of ecological sustainability and eco-dictatorship. After discussing the effects of different regime types, taking into account different structural, institutional and actor-centred theoretical approaches (formulation of hypotheses) in Section 2, the dependent and independent variables for the empirical analysis are operationalised in Section 3. A two-stage process is employed for the quantitative description and explanation of the performance results for more than 130 countries (all countries were considered, with the exception of the micro-states having fewer than three million inhabitants) for the period 1990–2005. The following two sections compare the performances of different regime types (Section 4) and conduct a multivariate regression analysis in order to explore the effects of a variety of institutional, economic and social variables (Section 5). Section 6 of this article summarises the findings of the analysis.

2. Ecological sustainability and eco-dictatorship

To understand what is meant by sustainable development, we can take the Brundtland Commission's definition as a starting point: 'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland 1987). From the perspective of intergenerational justice, sustainable development is the expansion of political responsibility beyond the generations living at present to take into account future generations. The concept therefore includes the aspects of justice and solidarity both between generations as well as on a global scale (Ekardt 2005, p. 9). Since the Rio Summit of 1992, sustainable development has referred not only to the realisation of social and economic goals but also to the long-term protection of the environment and resources, creating a magic sustainability triangle (George and Kirkpatrick 2007, Strange and Bayley 2009). So, in addition to long-term economic and social goals, a key component of responsibility today is the protection of the environment and natural resources both now and in the future in the interest of ecological sustainability (Lafferty 2004, p. 193). This dimension of sustainability will be the focus of this paper.

A further key distinction for this study is the differentiation between weak and strong ecological sustainability (Grunwald and Kopfmüller 2006, pp. 32–33, Neumayer 2010). In terms of the 'capital approach' (Strange and Bayley 2009, p. 105), it is crucial to know whether natural capital must be preserved absolutely intact ('strong sustainability'), or whether it is substitutable to some extent by artificial (financial, produced, human or social) capital ('weak sustainability';

Dietz and Neumayer 2006, Grunwald and Kopfmüller 2006, pp. 32–33, Strange and Bayley 2009, p. 106, Neumayer 2010, p. 1).

As far as the sense of weak sustainability is concerned, short-term (technical) adaptation measures are sufficient for solving (regional) environmental problems (as long as the production of artificial capital exceeds the destruction of natural capital). A further assumption here is that 'technical progress can overcome any resource constraint' (Neumayer 2010, p. 22). However, in the sense of strong sustainability, fundamental behavioural and lifestyle changes are necessary to ensure that a country's natural resources are maintained intact as much as possible. Strong sustainable development is more demanding, both ethically and substantively, than simply eco-modernising the existing economy (Lafferty 2004, p. 15).

The question that arises next is this: how can ecological problems in a country been solved according to the requirements of weak or strong sustainability? Is regime type of particular importance for this? Before we address the measurement of the empirical results for this question, it would be reasonable to reflect on the relationship between (weak and strong) ecological sustainability and regime type on a theoretical level with the help of structural, institutional and actor-centred approaches.

In keeping with the 'Churchill hypothesis', which describes democracy as the relatively best regime type,[2] we can assume that democracies have advantages over non-democratic regimes in their performance of ecological sustainability. This assumption arises from the results of numerous studies which indicate the strengths of democracies in their 'very own core areas of expertise', such as input legitimation (through free and fair elections), guaranteed participation and consideration of the preferences of today's (voting) citizens (Schmidt 2010, pp. 474–475). Moreover, recent studies on various economic (Gerring *et al.* 2005, Keefer 2007, Knutsen 2011), social (Zweifel and Navia 2000, McGuire 2010) and security policies (Bueno de Mesquita *et al.* 1999, Tangeras 2009) also seem to illustrate the advantage held by democracies in terms of their outcome performance (very prominently Halperin *et al.* 2008).

On the other hand, if we consider output performance autocratic steering may be '– if not in general, then at least in times of crises – more effective than democratic policy formation and implementation', as seen in some states, such as China and Singapore, during the recent financial crisis (Fliegauf and Sanga 2010, p. 1; for potential benefits of autocratic steering, see also Beeson 2009, Wurster 2011). This is based on the assumption that government action and steering are of central importance for solving fundamental public problems. Against this background and in light of the major environmental problems that remain unsolved, the resurgence of autocratic steering and the installation of 'a well-intentioned, well-informed tyranny' (Jonas 1985, p. 147) could possibly be a necessary and logical solution (Beeson 2009). Even the Club of Rome's *Limits to growth* report said 'that the scarcity of resources would render the suspension of democratic rule and the adoption of eco-authoritarian policies a necessity of human survival' (Meadows *et al*. 1972, Blühdorn 2011, p. 1).

When considering the enforcement of political decisions, democratic systems can indeed be criticised for the special difficulties they experience in pushing through unpleasant, hard but necessary reforms by force, especially for the implementation of strong sustainability goals, in contrast to autocratic regimes. It is hardly possible for democratic governments to rule without resistance because they must consider the electorate and often face a high number of institutional veto players (Tsebelis 2002). This can lead to lengthy and tough decision-making and negotiation processes, which can end with results on the level of the lowest common denominator of all participating actors (Scharpf 1997). But in order to solve major environmental problems, '(a)ction instead of deliberation is needed and, so the argument, authoritarian politics might be the only viable solution to overcome the resistance of manifold stakeholders

and veto players', who see ecological measures as detrimental to their short-term economic interests (Fliegauf and Sanga 2010, p. 2).

The high capacity to act of autocratic regimes[3] – is dearly bought, however. It can be argued that an autocracy, which must usually enforce its policy decisions with the aid of repression of one form or another, is seriously handicapped. The massive use of repressive measures that many autocracies depend on due to the low degree of input legitimisation[4] leads to a distorted perception of reality by the political leadership over time as the government is no longer supplied with reliable information by its subjects (insufficient political feedback loop). Such a problem is aggravated by the dictator's dilemma described by Wintrobe (2009). The more a dictator rules by repression, the less reliable information he can expect from the population. This can be a big disadvantage as far as the implementation of reasonable environmental protection measures is concerned. The use of repression in autocracies can even cover up – to a certain degree and for a limited period of time – weak legitimacy produced by poor ecological output performance (Schmidt 2012). Some autocrats may even use an adverse ecological situation to frustrate and harm their peoples or enemies.

This brings us to the issue of the abuse and degeneration of power. Basically, one can proceed from the assumption that stable arrangements in a political system are more likely to facilitate a (strong) sustainability policy, which relies on a long-term stable framework (Olson 2000, Gandhi and Przeworski 2007, Gandhi 2008). Following Padro i Miquel (2007) autocracies are characterised by significantly less institutional stability when contrasted with democracies. They also have much greater difficulties in organising a regulated transition to a new ruler (succession crisis) without experiencing fundamental regime upheavals (Niskanen 2003, p. 13). But even if one bases one's arguments on Olson's (1993) stationary bandit thesis, which states that the expectation of a long reign in autocracies can lead to long-term, goals-oriented policies (Besley and Kudamatsu 2007, p. 6), there remains the problem of the degeneration of authoritarian rule (i.e. collapse into corruption; Stretton 1976, pp. 26–34) in cases where effective government control is missing. In this context, one can argue that a lack of public control and political competition (both of which are notoriously absent in autocracies without free elections, Faust 2007, p. 6) can impede a sustainable policy over time. 'While in democracies social stability might give politicians the breathing space to tackle environmental issues, in autocracies it might allow elites to carry on with unsustainable practices' (Ward 2008, p. 395).

Besley and Kudamatsu (2007) assume that democratic regimes are characterised by permanent incentives for policy optimisation, at least in regard to weak sustainability, due to strong political competition.[5] Such incentives are missing in most of the consolidated autocracies. The assumption is that if a dictator cannot be easily removed from office, he will perform very poorly (Besley and Kudamatsu 2007, p. 7, Clark *et al.* 2011, p. 6). The transparent and publicly controlled decision-making processes in democracies may also facilitate their learning and error-correction capabilities, because deficiencies are likely to become known (a form of early warning system) and because rulers in democracies are motivated by their accountability to the citizens to constantly look for better policy solutions. 'Concerned citizens can influence political outcomes through the ballot box, pressure groups, social movement activity, the free media and through local political structures, but these channels are to a greater or lesser extent closed in autocracies' (Payne 1995, Ward 2008, p. 387). In an open policy process, it is possible for stakeholders, such as environmental organisations representing future-oriented policy interests, to gain a hearing. On the one hand, a democratic government's focus on the acute management of upcoming challenges (weak sustainability), generated by the electorate, increases under the pressure of a short-term deselection process and the impression of a permanent campaign atmosphere (short-lived political timeframe, Linz 1998). On the other hand, there is however the permanent risk of present interests being given excessive weight and solutions to long-term problems being shifted to the future.[6]

So the final question that arises is this: for whom are the policies in different regimes devised? Adherents of the rational choice theory of Bueno de Mesquita *et al.* (2003) believe that the opportunity to gain influence on political decisions is much broader in democracies than in autocracies. Because the 'selectorate' in democracies, unlike in autocracies, comprises all voting citizens living today; a democratic government must satisfy the interests of broad segments of the population to a much higher extent than an autocratic government would in order to be able to create a 'winning coalition' as the basis of its rule (Sharma 2007, p. 37). Democratic governments therefore need to provide more public goods, which include environmental protection measures, at least in terms of weak sustainability.[7] For autocratic rulers, who only have to consider the interests of a very small 'winning coalition' (usually consisting of major military elites, senior party delegates or economic elites), it is more rational to provide private goods to exclusive population groups.

> Their control of a high fraction of society's resources encourages them to pay off members of their relatively small support coalition by allowing them to pillage the ecosystem, as there is less political advantage in providing public goods such as environmental quality. (Ward 2008, p. 387)[8]

A crucial aspect to be considered when examining the impact of sustainability is the extent to which the interests of future generations are neglected by the 'selectorate', which in democracies can only consist of all of today's living (voting) citizens. It is possible to take future interests into consideration in democracies, especially if doing so would lead to distinct advantages for the current electorate as well as for future generations. But if this is not the case, as frequently occurs in the implementation of measures to achieve strong sustainability,[9] democracy's tendency to concentrate on satisfying immediate present interests (Blühdorn 2011, p. 3) could be a major problem.

The theoretical arguments presented so far allows us to make differentiated statements regarding supposed systematic performance patterns not only at the level of regime type (democracy versus autocracy) but also at the level of regime subtypes. Following Brooker (2009), different regime subtypes may vary not only in term of institutional stability, inclination towards repression and the ability to reform, but also in the inclusiveness of future interests. Their potentially greater ability to reform, combined with a lower number of veto players, could give the parliamentary and the presidential systems advantages over semi-presidential systems. The transition of power in monarchies, which tends to be regulated, should work to its advantage for an ecological sustainability performance that is superior to that of the other autocratic subtypes. Recent studies (e.g. Hadenius and Teorell 2007) show that civilian dictatorships, especially party regimes, can also be very durable. In contrast, military dictatorships, which are often based on mechanisms of repression and last only a short time, may have additional difficulties acting in an ecologically sustainable way. However, as we argued above, stable autocratic rule can also lead to degeneration of the 'stationary bandit' if power control (through competition within the system) is too low. This could be especially disadvantageous for achieving long-term sustainability goals. In addition, the relatively narrow 'winning coalition' in monarchies and military dictatorships, whose primary support groups have little special affinity for environmental issues, is likely to complicate the inclusion of environmental concerns, particularly in terms of strong sustainability.

Now that we have completed the theoretical considerations, three hypotheses can be formulated.

Due to their higher implementation and information processing capacities, increased political competition (high error-correction, innovation and problem-solving capacities) and wider inclusiveness in favour of present public goods democracies should perform better with regard to weak ecological sustainability than autocracies (Hypothesis 1).

Despite their stable institutional framework and the protective devices that have been developed to prevent degeneration of power, democratic regimes have problems to include future interests into their decision-making processes and to enforce them against present resistance, because of their short-lived political timeframe. Therefore we can assume that there is no significant difference between democratic and autocratic regimes with regard to strong ecological sustainability (Hypothesis 2).

Coming to regime subtypes we can expect that semi-presidential regimes achieve systematically worse results than presidential and parliamentary regimes with regard to weak and strong sustainability performance. Among autocracies, monarchies should achieve the best results with regard to weak sustainability while civilian dictatorships should perform best in terms of strong ecological sustainability (Hypothesis 3).

3. Operationalisation

3.1 *Weak and strong sustainability*

The article uses three indicators for weak and strong sustainability each to measure countries' performance of sustainability in the period from 1990 to 2005.[10] In the current debate on sustainability measurement (Ekins and Simon 1999, 2001, Deutscher Bundestag 2012), it has been pointed out that performance indicators must satisfy certain quality criteria. So we use indicators which are easy to standardise, which are not based on subjective assessments, which are comprehensible and where the direction of the sustainability target is clear. For this investigation, the change over time has been taken into account for a set of indicators which are not aggregated into an index. In this way, each dimension of sustainability can be analysed in a differentiated way while also addressing the breadth and depth of sustainability efforts.

The benchmarks used for aspects of weak sustainability – dimensions related to adaptivity, substitutability and the treatment of symptoms only – are the proportion of renewable energies in the total energy consumption mix, the number of designated nature protection areas and the energy efficiency of a country. These indicators are directed at short-term or spatially limited effort and adaptation measures. While high energy efficiency and a high share of renewable energies lead to a more efficient and careful use of natural resources, this is not necessarily linked to a decline in consumption of resources as a whole, because there is the risk of an ecological rebound effect (Sorrell 2007). So efficiency gains alone are not sufficient to reduce total resource consumption and ecological destruction. Thus, they can be overcompensated if they are not connected to a sufficiency strategy (Alcott 2008) based on strong sustainability goals. Regional environmental problems can be solved by extending nature protection areas. In non-protected areas, a substitution of natural capital through other forms of artificial capital is however still possible.

Common indicators for strong sustainability (Deutscher Bundestag 2012) include the national CO_2 emissions as the most important greenhouse gas, responsible for over 70% of projected global warming (Ekins and Simon 2001), waste production and energy consumption of a country. A reduction in CO_2 emissions, waste production and energy consumption indicates serious steps towards strong sustainability. Real lifestyle changes in the sense of a sufficiency strategy are necessary in order to diminish these ecological loads, while a pure substitution strategy is not sufficient for this purpose (for a detailed description of the performance indicators see Table 1).

3.2 *Regime type*

When considering the types of political regimes, one can imagine a continuum of possible characteristics, with ideal (stable and inherent) democracy at one pole and a perfect autocratic

Table 1. Performance indicators of ecological sustainability.

Dimension of ecological sustainability	Performance indicator used
Weak sustainability	
Share of renewable energies	Share of renewable energies in the total energy consumption. *Source*: The World Bank (2011)
Designated nature protection areas	Proportion of protected areas: marine and terrestrial. *Source*: UNSD (2012)
Energy efficiency	Gross domestic product (GDP) per unit of energy use. *Source*: The World Bank (2011)
Strong sustainability	
Climate emissions	CO_2 emissions in metric tons *per capita*. *Source*: The World Bank (2011)
Municipal waste production	Municipal waste collected per thousand inhabitants. Calculated by the author. *Source*: UNSD (2012)
Energy consumption	Energy use: kilogram of oil equivalent per thousand inhabitants. Calculated by the author. *Source*: The World Bank (2011)

(totalitarian) regime at the other (Merkel 2010, p. 25). For regime classification, we have several data sets to rely on (Hadenius and Teorell 2007, Cheibub *et al.* 2009b, Geddes *et al.* 2011), all of which differ in terms of their theoretical conceptualisation and classification criteria, the number of regime types differentiated and the measurement levels used. A crucial distinguishing factor is whether a graded/continuum/scalar approach for classifying regimes is being used which is based on diminished versions of perfect democracy and perfect autocracy, inhabiting some middle ground such as electoral authoritarianism (Schedler 2006), defective democracy (Croissant 2010), etc., or whether a binary distinction between democracy and autocracy is being utilised, which allows an institutional differentiation in regard to regime subtypes. In order to answer the research questions on which this paper is centred – focusing on a clear distinction between the effects of democracy and autocracy – the second mode of classification seems more appropriate.

This, however, leads to the following question: Which constituent characteristics permit a clear distinction between regime types? On the basis of which central aspects can democracies, in which a majority of the people rules, be distinguished from autocracies, in which the power of decision lies with one autocrat, a single person or a collective actor, who is not limited either in terms of personnel nor by any institutions? In contrast to the very broad definition of democracy expressed in Abraham Lincoln's famous Gettysburg Address of 1863 – 'Government of the people, by the people and for the people' or the concept of 'embedded democracy', in which political and civil freedom as well as equality and control are considered to be constitutive characteristics of a democracy (Croissant 2010, p. 95), a concept as lean as possible will be used to differentiate regime types in the following. Based on the definition of democracy by Dahl which includes public contestation and the right to participate, the existence of 'contested elections' is deemed a central criterion for the distinction between democracy and autocracy. For a regime to be classified as democratic, both the executive and legislature have to be legitimised by means of elections, and the opposition must have a real chance to win in the elections. To this end, three conditions have to be fulfilled:

(1) *Ex ante* uncertainty: the outcome of the election is not known before it takes place
(2) *Ex post* irreversibility: the winner of the electoral contest actually takes office
(3) Repeatability: elections that meet the first two criteria occur at regular and known intervals (Cheibub *et al.* 2009a, p. 69)

Only if these conditions are all fulfilled can one speak of a democracy, whereas in the other case we are dealing with an autocracy. The advantage of the chosen definition, which discriminates narrowly between regime types but does not include aspects of either the separation of powers or of civil rights, is the fact that this definition examines central institutional and procedural characteristics of regimes but does not include the policy dimension of democracy. For the analysis, we use the current 'Democracy and Dictatorship' data set by Cheibub *et al.* (2009b) as a 'lean indicator'. It is not only based on the above-mentioned criteria for differentiating between the regime types – according to this, a regime is a democracy if all of the following conditions are fulfilled:

> 1. The chief executive must be chosen by popular election or by a body that was itself popularly elected. 2. The legislature must be popularly elected. 3. There must be more than one party competing in the elections. 4. An alternation in power under electoral rules identical to the ones that brought the incumbent to office must have taken place (Cheibub *et al.* 2009a, p. 69)

– but also offers a comprehensive data set in longitudinal and cross-sectional comparison. It is also characterised by a high construct and content validity and allows further differentiation of regime subtypes (see Roller 2013). After the dichotomous discrimination between democracy and autocracy, parliamentary, semi-presidential and presidential subtypes can be distinguished as institutional variations within the democratic spectrum with the help of this data set. A distinction is possible by answering two successive questions: '1. Is the government responsible to the assembly? 2. Is there a head of state popularly elected for a fixed term in office?' (Cheibub *et al.* 2009a, p. 81). Autocracies can be further divided into civil dictatorships, military dictatorships and monarchies by answering the successive questions:

> 1. Who is the effective head of government? 2. Does the head of government bear the title of 'king' and have a hereditary successor and/or predecessor? 3. Is the head of government a current or past member of the armed forces? 4. Is the head neither monarchic nor military? (Cheibub *et al.* 2009a, p. 87)

3.3 *Further political, economic and social factors*

To test whether the regime effects discussed above are robust, the influence of other (control) variables has to be examined in the following analysis. The stability of a regime, in addition to specific regime characteristics, can be the central basis for successful long-term policy. However, a degeneration of power can also occur in stable regimes, in such cases where power limiters and competitive mechanisms are unable to prevent this. Hence, to take these boundary conditions into account, both institutional 'Checks and Balances' on government power and 'Degree of Decentralisation' also have been included as control variables in the analysis. The assumption here is that institutional 'Checks and Balances' cannot only curb the abuse of power by the government, but can also facilitate control over whether environmental regulations are implemented in an appropriate manner. In addition to their power-limiting effect, a decentralised state structure could promote situation-adequate reactions to spatially restricted environmental problems. On the other hand, the centralisation of governmental power may facilitate overcoming current self-interest (Ward 2008, p. 387) by disengaging regional veto players.

In addition to these political determinants, economic factors may also play an important role in a country's sustainability performance (Keefer 2007). Hence, it is useful to consider a country's stage of economic development and its resourcing in the later analysis as potential explanatory variables. In this context, it can be argued 'that as countries get richer, environmental quality first deteriorates, then eventually starts to improve' (Ward 2008, p. 392). Here 'two factors could be at work: movement from agriculture into relatively dirty manufacturing and finally into a cleaner economy; or, with increased income, growing demand for a clean

environment' (Grossman and Krueger 1995, Przeworski and Limongi 1997, Ward 2008, p. 392). With a rising level of economic development, the technical possibilities for removing certain (spatially restricted) environmental problems should also increase (end of pipe solutions, weak sustainability). Developed economies might however have special difficulties in initiating significant steps towards a basic change in their environmental behaviour for the purposes of strong sustainability, despite significant increases in ecological pressure. Under the conditions of a high level of prosperity, cuts and abstinence in favour of future environmental interests may be perceived as particularly painful (because they mean the loss of existing wealth) and so may hardly be enforceable. In any case, the effects of the economic development level and of economic growth should be checked both for weak and strong sustainability.[11] In view of the resourcing of a country (measured by the energy import dependency), different lines of argumentation can also be distinguished. On one hand, it can be supposed that a country with large raw material inventories should have, ceteris paribus, more resources to invest for the future and for environmental protection. On the other hand, a country with an abundance of raw materials, in particular the oil and gas exporting countries, will promote its pollution-intensive industrial branches in a special manner to achieve comparative cost advantages. This, however, may negatively affect its pollution balance.

Apart from economic factors, social factors can also impair the sustainability performance of a country. The ageing structure of a society might be important in this context (Kielmansegg 2003, p. 586). It can be argued that the interests of the younger generations, who are hard to organise in an ageing society, are systematically neglected because of the existence of powerful distributional coalitions formed by older population groups (Olson 1982). This can be a problem for strong sustainability targets. While a large population and, more particularly, a high population density might, ceteris paribus, increase pollution, especially in urban areas, they could also increase the pressure to take short-term environmental protection measures because of the increased visibility of environmental problems.

Finally, with regard to international factors, the transnational interconnectedness of a country (measured by the degree of openness of its economy) has been chosen as a control variable for the following analysis. On the one hand, a strong involvement in international processes could be the functional equivalent of competitive pressures towards strict environmental regulation from the inside. In addition, international learning processes can spread environmental innovations in a country and stimulate best practice processes. On the other hand, trade liberalisation in open economies may lead to regulatory races to the bottom of lower environmental standards (Damania *et al.* 2003). For these reasons, the influence of this factor is controversial.

However, this is not true for the last explanatory factor used here. The more a country is affected by armed conflicts, the greater the environmental damage can be expected to be and the fewer resources the country may have in order to fix this damage. All of these assumptions (see for the mentioned explanatory factors Table 2) will be examined in the next sections.

4. Comparison of performances

A glance at the average results for weak sustainability performance of different regime types and subtypes shows a significant advantage of democratic regimes in comparison with autocracies (Table 3, columns 2, 3, 4). This effect however appears to be absent or is even reversed in the findings for strong sustainability performance (Table 3, columns 5, 6, 7). In contrast with the three indicators of weak sustainability, where a high value indicates a high performance (large share of renewable energy, many nature protection areas, high energy efficiency), there is an inverse relationship for all of the indicators of strong sustainability. A high value here

Table 2. Explanatory factors for ecological sustainability.

Category	Explanatory factors	Description
Political factors	Regime type democracy/ autocracy	Democracy dictatorship index. *Source*: Cheibub *et al*. (2009b)
	Regime subtype	Indicators for democratic and autocratic regime subtypes. *Source*: Cheibub *et al*. (2009b)
	Checks and balances	Checks and balances. *Source*: Keefer (2010)
	Degree of decentralisation	Autonomous regions. *Source*: Keefer (2010)
Economic factors	GDP *per capita*	GDP *per capita*. *Source*: The World Bank (2011)
	GDP growth	GDP percentage growth per year. *Source*: The World Bank (2011)
	Energy imports	Net energy imports as a percentage of energy consumption. *Source*: The World Bank (2011)
Social factors	Total population	Total population. *Source*: The World Bank (2011)
	Population density	Population density. Calculated by the author. *Source*: The World Bank (2011)
	Population ageing	Proportion of the population over 65 years in the total population. *Source*: The World Bank (2011)
International factors	Openness of economy	Imports and exports relative to GDP. Calculated by the author. *Source*: The World Bank (2011)
	Intensity of armed conflicts	Intensity of armed conflicts. *Source*: Schwank *et al.* (2013)

Table 3. Mean comparison of regime types.

Regime type	Share of renewable energies	Designated nature protection areas	Energy efficiency	Climate emissions	Municipal waste	Energy consumption
Overall	10.63	9.56	5.14	3.88	0.39	2.71
Democracy	14.47	10.68	6.03	4.98	0.42	3.84
Parliamentary democracy	12.18	9.30	6.11	7.16	0.47	3.17
Semi-presidential democracy	15.79	7.97	5.17	5.34	0.40	2.77
Presidential democracy	16.23	13.71	6.44	2.62	0.34	5.12
Autocracy	4.95	8.27	3.86	2.61	0.26	1.22
Civilian dictatorship	6.36	8.98	3.47	2.92	0.33	1.30
Military dictatorship	1.69	6.28	4.51	1.46	0.17	0.81
Monarchy	1.37	12.04	5.21	5.81	0.23	1.97

indicates a particularly low sustainability performance (comprehensive climate emissions, high waste production and high energy consumption).

A closer examination of the data reveals an interesting picture as far as the regime subtypes are concerned. While presidential democracies perform better than parliamentary and semi-presidential ones within the democratic spectrum as far as weak and strong sustainability are

concerned,[12] the results are rather mixed within the autocratic spectrum. Monarchies and civilian dictatorships are superior to military regimes with regard to weak sustainability. With regard to strong sustainability, however, the story is different. Here, monarchies perform worse than their autocratic counterparts, while civilian autocracies achieve significantly better results than the mean of the democratic states.[13]

Considering the findings, the variance between subtypes of democratic and autocratic regimes implies that comparative averages alone are not sufficient for explaining performance results. Rather, in view of the regression analysis that follows, it is useful to bring a larger number of explanatory variables into the analysis.

5. Regression analyses

The regression results for the performance indicators of weak and strong sustainability (presented in Table 4) call attention to a multitude of interesting findings.

If we look first at the results for weak sustainability (model 'Share of renewable energies', 'Designated nature protection areas' and 'Energy efficiency'), we can see a robust and positive effect in every model in favour of democratic regimes. It is noteworthy that this positive effect of democracy turns out to be significant even when other important political, economic, social and international factors are included. However, the results for strong sustainability (model 'Climate emissions', 'Municipal waste' and 'Energy consumption') clearly differ from those of the former models. A weak but significant positive effect of democracy is present here only with regard to municipal waste reduction. The effect of democracy on the avoidance of CO_2 emissions and high energy consumption is even negative, without a significant level of explanation being reached, though. So the performance of democracy is clearly divided between weak and strong sustainability. Even if we use another indicator to capture the degree of democratisation and autocratisation, (such as the Authoritarian Regimes data set by Hadenius and Teorell (2007) as the imputed average between Polity 4 and Freedom House scores), this result stays basically the same.

Taking a closer look at the effects of specific regime subtypes, we can observe the significant negative effect of monarchies in terms of strong sustainability. This effect seems only partly influenced by the great wealth of fossil resources, which is characteristic of many countries classified as monarchies. On the other hand, a military regime seems to result in a country's below-average performance, both for weak and strong sustainability. This effect is particularly strong in relation to the designation of protected areas and the prevention of waste. Within the democratic spectrum semi-presidential democracies have a negative effect on both sustainability dimensions, though not at a high level of significance. In addition to this, parliamentary systems seem to have special deficits in designating nature protection areas.

While other political factors (degree of 'Checks and Balances' and 'Decentralisation') can hardly claim explanatory power,[14] this is not true for the economic parameters. It must be stated that a decoupling of economic development from the level of pollution has not yet been reached (no inverted u-curve for trends in ecological damage). While success in the area of weak sustainability seems possible even without a high level of economic development, it is simultaneously a handicap in achieving strong sustainability objectives. Moreover, an economic growth strategy does not seem to be a solution to fundamental environmental problems (see all of the models of strong sustainability). This is also the case for the resource wealth of a country, which contributes to an increase in climate emissions and energy consumption.[15]

We can complete the quantitative performance analysis by taking into consideration social and international factors. While the age structure of a society unexpectedly appears to have no significant impact on the performance of sustainability, a large population and a high population

Table 4. Regressions of weak and strong sustainability.

	Weak sustainability						Strong sustainability					
Model	Share of renewable energies		Designated nature protection areas		Energy efficiency		Climate emissions		Municipal waste		Energy consumption	
Regime type democracy/ autocracy	1.22*** (0.41)	0.04	0.41** (0.21)	0.02	0.05** (0.02)	0.01	0.02 (0.03)	0.01	−0.01* (0.01)	−0.02	0.01 (0.01)	0.01
Regime subtype parliamentary democracy	−0.68 (0.46)	−0.02	−0.49** (0.24)	−0.02	0.01 (0.02)	0.01	0.01 (0.03)	0.01	0.01 (0.01)	0.01	0.01 (0.01)	0.01
Regime subtype semi-presidential democracy	−0.01 (0.55)	0.01	−0.41 (0.29)	−0.01	0.03 (0.03)	0.01	−0.01 (0.04)	−0.01	0.01 (0.01)	0.01	0.01 (0.01)	0.01
Regime subtype military dictatorship	−0.45 (0.41)	−0.01	−0.34* (0.21)	−0.01	−0.01 (0.02)	−0.01	0.01 (0.03)	0.01	0.01* (0.01)	0.01	0.01 (0.01)	0.01
Regime subtype monarchy	−0.74 (0.87)	−0.01	0.12 (0.40)	0.01	−0.05 (0.04)	−0.01	0.12** (0.06)	0.01			0.01*** (0.01)	0.01
Checks and balances	−0.07 (0.09)	−0.01	0.01 (0.05)	0.01	−0.01 (0.01)	−0.01	0.01 (0.01)	0.01	0.01 (0.01)	0.01	0.01** (0.01)	0.01
Degree of decentralisation	−0.10 (0.36)	−0.01	−0.14 (0.20)	−0.01	−0.02 (0.02)	−0.01	−0.01 (0.03)	0.01	0.01 (0.01)	0.01	0.01 (0.01)	−0.01
GDP *per capita*	0.01 (0.01)	0.01	0.02* (0.01)	0.02	0.01 (0.01)	0.01	0.02** (0.01)	0.01	0.01*** (0.01)	0.05	0.01** (0.01)	0.01
GDP growth	0.01 (0.02)	0.01	0.01 (0.01)	0.01	0.01 (0.01)	0.01	0.03*** (0.01)	0.02	0.01** (0.01)	0.02	0.01*** (0.01)	0.02
Energy imports	−0.01 (0.01)	−0.01	0.01 (0.01)	−0.01	0.01 (0.01)	0.01	−0.02** (0.01)	−0.01	0.01*** (0.01)	0.03	−0.01*** (0.01)	−0.01
Total population	0.01 (0.01)	0.01	0.01 (0.01)	−0.01	0.01 (0.01)	0.01	0.01 (0.01)	0.01	−0.01* (0.01)	−0.01	−0.01 (0.01)	−0.01
Population density	0.01 (0.01)	−0.01	0.01 (0.01)	−0.01	0.01 (0.01)	−0.01	0.01 (0.01)	0.01	0.01 (0.01)	0.01	−0.01*** (0.01)	−0.01
Population ageing	0.06 (0.05)	0.02	−0.04 (0.03)	−0.02	0.01 (0.01)	0.01	0.01 (0.01)	0.01	0.01 (0.01)	0.01	0.01 (0.01)	0.01
Openness of economy	0.02** (0.01)	0.02	−0.01 (0.01)	−0.01	0.01 (0.01)	0.01	0.01 (0.01)	0.01	0.01 (0.01)	−0.01	0.01 (0.01)	−0.01
Intensity of armed conflicts	−0.13* (0.08)	−0.02	−0.01 (0.04)	−0.01	0.01 (0.01)	0.01	0.01 (0.01)	0.01	0.01 (0.01)	0.01	0.01 (0.01)	−0.01

(*Continued*)

Table 4. Continued.

	Weak sustainability						Strong sustainability					
Model	Share of renewable energies		Designated nature protection areas		Energy efficiency		Climate emissions		Municipal waste		Energy consumption	
Time trend	−0.02 (0.03)	−0.01	−0.17*** (0.01)	−0.08	0.01*** (0.01)	0.01	0.01 (0.01)	0.01	0.01 (0.01)	−0.01	0.01 (0.01)	0.01
Lagged dependent variable	0.92*** (0.01)	0.91	0.95*** (0.01)	0.95	0.98*** (0.01)	0.98	0.98*** (0.01)	0.98	0.94*** (0.01)	0.94	0.99*** (0.01)	0.98
Constant	40.31 (61.65)		357.33*** (33.23)		−9.46*** (3.43)		0.04 (4.91)		0.01 (0.01)		−0.01 (0.01)	
R^2	0.95***		0.91***		0.98***		0.98***		0.98***		0.98***	
Corrected R^2	0.89		0.91		0.98		0.98		0.98		0.98	
N	1391		1500		1468		1495		344		1500	

Notes: All explanatory variables were taken into account with a time lag of one year ($t-1$). To avoid autocorrelation of the residuals, a lagged dependent variable was included in addition to a time variable in all the models (in the model 'Share of renewable energies' with a lag of two years). However, the core results still remain the same, obtaining models with non-lagged dependent variables. All models were checked for heteroscedasticity, multicollinearity and a non-normal distribution of outlying factors. To avoid multicollinearity, the regime subtypes of presidential democracy and civil dictatorship were excluded in all models. Owing to the smaller sample size in the model 'Municipal Waste', the variable 'Regime Subtype Monarchy' had to be removed. The partial regression coefficient together with the relative standard error (in parentheses) stands in the left field for each variable. The right field contains the standardised partial regression coefficient.

*Significance of 90%.

**Significance of 95%.

***Significance of 99%.

density have a dampening effect on a country's waste production *per capita* and energy consumption *per capita*. In accordance with the theoretical expectations, the international factor 'openness of economy' seems to promote the expansion of renewable energies. However, this expansion is hampered if a country is affected to a considerable degree by conflict.

6. Conclusion

On examining the results of this theoretical and empirical investigation, we see that there is both good and bad news for advocates of democracy. The good news is that democracy has a clear advantage with regard to weak sustainability. The bad news is that this is not true for strong sustainability. These results correspond to the theoretical expectations formulated in hypotheses 1 and 2. Although both the theoretical analysis and empirical studies do not provide evidence for the superior problem-solving capability of autocracies for issues of ecological sustainability, the superiority of the democracies over the autocracies is limited to the solution of area-restricted environmental problems and those that are technically easy to solve. This implies that democracies adapt to, but do not really solve, major environmental problems.

These differing results, which depend on the dimension of ecological sustainability, can be explained by several theoretical approaches. The superiority of the democratic vis-a-vis the autocratic regimes in solving easy to manage, substitutable problems of weak sustainability seem essentially to be based on their greater ability to include present (public good) interests into their politics (inclusiveness for a wider range of interests, especially ecological ones). In addition, the institutionalised political competition within a democracy facilitates an efficient adaptation to environmental problems that appear to be both short-term and solvable in the short term. Reasons for this are the high error correction, innovation and problem-solving capacities of democracies and their sensitive feedback loop with regard to new environmental problems.

Democracies display significant deficits, however, in overcoming long-term environmental problems for which there are no cheap technical solutions, but which must be rectified by means of fundamental changes in lifestyles and the economy. As the empirical analysis shows, most democracies have difficulties in including future interests into their current decision-making processes (because of the short-lived political timeframe), despite their stable institutional framework and their measures protecting against the degeneration of power. In addition, their steering ability does not often seem sufficient to overcome current stakeholder interests that resist moves towards strong ecological sustainability. Although this is a thorn in the side of democracy, the performance results for strong sustainability do not provide any evidence for the general superiority of autocratic regimes. Even stable autocracies either have no higher steering ability, unlike the majority of democracies, or have not used it to initiate a strategy for (strong) ecological sustainability. Taken as a whole, the empirical study shows no evidence for the superior problem-solving capacity of eco-dictatorship, in terms of both weak and strong sustainability. This discovery should be given greater consideration in the theoretical debate on this issue in the future.

In addition to this finding, it has become clear that a dichotomous distinction between democracy and autocracy is not sufficient to explain the performance results. This can be demonstrated by large differences between regime subtypes; sometimes the variance within a regime type can be greater than that between regime types. The results deviate in their details from the theoretical expectations, as formulated in Hypothesis 3. Within the democratic spectrum, presidential regimes achieve, as expected, very good results, while the narrow winning coalition in monarchies seems to undermine their willingness to initiate changes necessary for strong sustainability. However military regimes, as predicted in the theory, lack the resources to achieve weak sustainability targets.

On the other hand, the characteristics of regime type are not the only relevant explanatory factor. The sustainability performance of a country is influenced by a variety of other parameters. In addition to economic development, which plays an ambiguous role, social and international factors, in particular, have to be considered.

These final remarks show how necessary further research is at this point. Not only should the theoretical connection between regime type and sustainability be investigated in more detail, further explanatory factors for ecological sustainability in a country (cultural factors, geographical and historical settings, etc.) should be examined as well. Even more attention should also be given to the differentiation of regime subtypes and the effects of interaction between different explanatory factors. A deeper understanding of the specific problems related to ecological sustainability could finally facilitate the development of badly needed solution strategies.

Notes

1. While Bernauer and Koubi (2009) and Kneuer (2012) find a positive effect of democracy in terms of air quality and pollution control, Midlarsky (1998) reports that democracies are associated with worse environmental performance than autocracies. Ward (2006) finds that the impact of democracy on a variety of ecological sustainability indicators is rather mixed.
2. Winston Churchill described democracy in 1947 as follows: 'No one pretends that democracy is perfect or all wise. Indeed, it has been said that democracy is the worst form of Government, except all those other forms that have been tried from time to time' (Churchill 1974, p. 7566).
3. Under certain circumstances, a high number of veto players can also exist in an autocratic system. How influential they actually are, is hard to determine, though, due to the non-transparency of decision-making processes.
4. The degree of repression can vary considerably from one authoritarian regime to the other. In the following, it is assumed that military regimes, in particular, use these means.
5. The extent to which a democracy has advantages with regard to strong sustainability depends, however, on the degree to which long-term, cumulative environmental problems are considered in democratic competitions.
6. While democracies usually provide a long-term stable institutional framework, political processes taking place within this framework tend to be aligned to a short time horizon.
7. This assumes, however, that environmental protection is demanded as an important task, at least by an important part of the democratic electorate.
8. So 'viewed from a rational choice perspective, authoritarian rulers do not have incentives to adopt, or to stick with, sustainable policies. They prioritise rapid economic development to gain legitimacy and to bolster external security' (Porritt 1984, p. 48, Ward 2008, p. 387).
9. Strong sustainability measures 'are designed to predominantly generate costs while adaptation policies may also generate potential benefits' for today's society and economy (jobs in the environmental sector, construction of infrastructure projects, etc.; Fliegauf and Sanga 2010, p. 6).
10. Owing to data constraints, records for data series reaching farther back are not available. A specific feature of the performance measurements made here is the use of policy outcome indicators. As a result, material results in a policy area can be recorded. Outcome indicators reflect the performance level in a policy area in relation to the objectives pursued (Roller 2011). This is a common method for measuring sustainable development (George and Kirkpatrick 2007, Strange and Bayley 2009). When comparing democracies with autocracies, we face however a twofold data problem. First, data access is much more difficult in the case of autocracies than of democracies (selection bias). Second, there is a risk that existing data are systematically falsified in autocracies (see Roller 2013). Even if generally accepted data sources (World Bank, UNSD) are evaluated, these issues must be considered in the interpretation. To increase the robustness of the performance measurement, indicators were chosen where autocratic states had little influence on information collection (there was a high level of international control). On the other hand, three independent indicators were considered for each dimension of sustainability.
11. The extent to which a close causal connection exists between the economic development of a country and its degree of democratisation is still a controversial issue. Because the effects of regime type might be 'confounded when wealth is not controlled' (Ward 2008, p. 392), the factor of economic development has to be considered.

12. One exception here is only the indicator of energy consumption. Parliamentary democracies perform slightly better than semi-presidential ones at weak sustainability, but not at strong sustainability.
13. The performance ranking for single countries shows that rich democracies (e.g. Switzerland, Sweden, Norway and Germany) remain at the top of the lists of weak sustainability indicators. Important autocratic states like China or Russia can be found in the lower percentiles of the country rankings. At the end of the lists there are only underdeveloped, war-stricken autocracies like Turkmenistan, Uzbekistan and Somalia. While only economically less developed countries perform well with regard to strong sustainability performance, we have two groups at the other, that is to say inferior, end of the lists: on the one hand, industrialised democracies (USA, Norway, Finland and Canada) and on the other hand, oil-rich autocracies (Saudi Arabia and Russia).
14. Whereas the 'Degree of Decentralisation' does not reach a significant level of explanation in any one of the models, contrary to theoretical expectations, the factor 'Checks and Balances' is significantly coupled with high energy consumption.
15. A country's heavy resource dependency, on the other hand, is also associated with high waste production.

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