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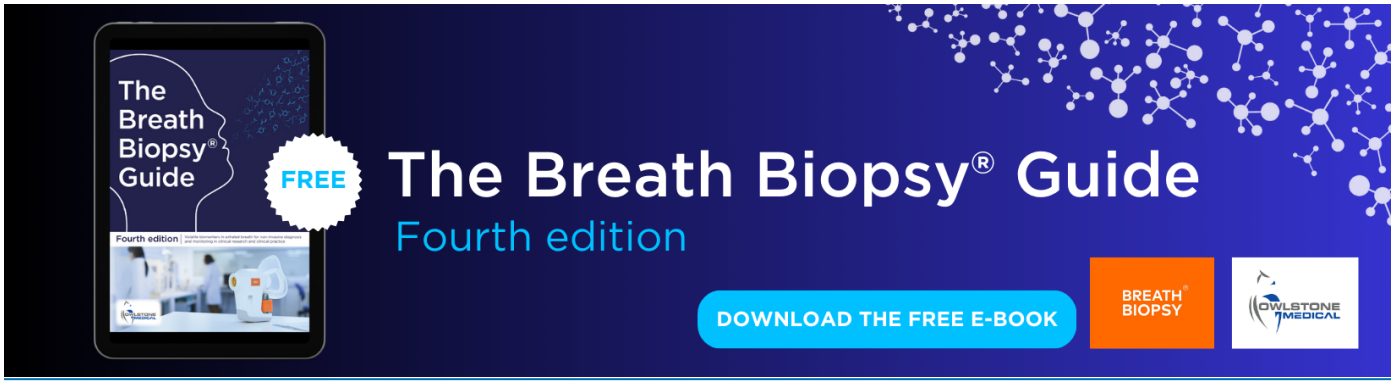

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LETTER

The relationship between female and younger legislative representation and performance on the Sustainable Development Goals (SDGs)*

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Abstract

Though the Sustainable Development Goals (SDGs) were crafted through an inclusive process, research on the relationship between greater female or younger legislative representation and SDG performance has been lacking. This article employs a linear mixed effects modeling approach to shed light on this relationship. Controlling for economic and democracy levels and population, the modeling reveals a positive correlation between female and youth legislative representation and SDG performance. Additional analyses, however, suggest the strength of the relationships with female and youth legislative representation vary between the socioeconomic and environmental SDGs. Female and youth representation are strongly correlated with the socioeconomic SDG index; they improve the fit of the model for the environmental SDG index. This result may stem from a tendency in developed countries to trade off the environmental SDGs for the socioeconomic SDGs. It may also imply that greater legislative representation is not sufficient to overcome constraints in energy and consumption and production systems that often lead to those trade-offs. Rather bringing women and younger people into legislatures may need to be combined with institutional and policy reforms that turn socioeconomic and environmental trade-offs into synergies.

1. Introduction

With the sustainable development goals (SDGs) set to expire in 2030, accelerating progress on the 17 goals sitting at the heart of the 2030 agenda on sustainable development is viewed with heightened urgency. These concerns are well founded: some reviews suggest that the world is on track to achieve the SDGs closer to 2060 than 2030 (UNESCAP 2022). The need to accelerate progress has drawn interest to the factors affecting performance on the SDGs. This rising interest has focused attention on the commitment to include diverse stakeholders in the formulation and implementation of the SDGs. It was also borne from the realization that multi-stakeholder support is needed to break through barriers that prevent progress on many of the inherently cross-cutting issues covered under the SDGs (Gusmão Caiado *et al* 2018). A set of actors that could both reflect these diverse perspectives and overcome barriers to progress are legislators and parliamentarians. Legislatures have a well-deserved reputation for spurring actions on progressive issues covered under everything from recent European climate policy (Buzogány and Ćetković 2021) to previous Canadian human rights policy (Nolan 1985). The ability to influence policy generally could also influence progress on the SDGs specifically.

The relationship between national legislatures and SDGs may nonetheless vary across countries. A possible reason for the variation is legislative

* This article is dedicated to the birth of Kai.

representativeness. Women and youth are often under-represented in legislatures (Wylie and Dos Santos 2016, Stockemer and Sundström 2018, Eyepix 2021). The lack of representation merits attention since some studies show that greater female representation can lead to the kind of environmentally-sound decisions that are central to the SDGs (Norgaard and York 2005, Ergas and York 2012). Similarly, research suggests greater female political representation influences other issues covered under the SDGs such as higher economic growth (Baskaran *et al* 2018) and less corruption (Swamy *et al* 2001). An additional line of research highlights that younger people may have more environmentally-conscious outlooks (Casey and Scott 2006)—though the effects are less robust and depend more on intervening variables (i.e. income and education levels) than gender (VanHeuvelen and Summers 2019). At the same time, younger representation in decision-making bodies are gaining ground in some countries as the environment and other progressive issues move up policy agendas (Joshi 2013).

Though the above studies point to a possible relationship between gender, age and environmental sustainability, research on how female or younger representation in legislatures and parliaments relates to SDG performance has been lacking. The current study fills this gap by quantifying the relationship between the presence of women and younger people in national legislatures and parliaments and performance on the SDGs. The article examines the above relationship through a linear mixed effect modelling approach. The dependent variable in the models is the SDG index from the Sustainable Development Solutions Network (SDSN) and Bertelsmann Foundation that is used to track countries' progress on the SDGs (Sachs *et al* 2021). The modeling is unique in that it helps quantify whether and under what conditions greater female and younger representation in legislatures relate to higher performance on the SDGs.

The next section of the article reviews relevant literature to develop hypotheses involving possible relationships between key variables. Sections 3 and 4 analyzes data to test those hypotheses. Section 5 discusses policy implications and areas for future research.

2. Literature review

2.1. The environmental dimensions of the SDGs

The eight millennium development goals (MDGs) (2000–2015) that defined the international development agenda prior to the SDGs have widely been viewed as a success (Sachs 2012). However, some of the success may have come at the expense of the environment. To a significant degree, the environment was an add-on to the MDGs. For instance, only MDG 7 had an environmental focus (Hezri 2013). Further, the MDGs paid limited attention to interrelationships between or within its goals or linkages with other environmental issues (Soares and Kok 2010). Since the MDGs, concerns that the world is crossing planetary boundaries and eroding safe operating spaces prompted decisions to feature the environment in the SDGs (Rockström *et al* 2009, Raworth 2012).

There are several ways the SDGs reflect the environment's relatively greater importance. One is the six standalone 'environmental' SDGs: SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 12 (responsible consumption and production), SDG 13 (climate action), SDG 14 (life below water) and SDG 15 (life on land). Another way involves attempts to strengthen integration across different dimensions into the SDGs structure. For example, targets on air pollution are under SDG 3 (good health and well-being) (Elder and Zusman 2016); other comparable examples include efforts to decouple growth from environmental stresses fall under SDG 8 (decent work and economic growth) (Elder and Loewe 2019). More generally, approximately 20 of the 70 SDG targets (about 30%) related to environmental issues are under socioeconomic SDGs.

Though the SDGs are more integrated than the MDGs, questions remain over whether they go far enough. Some of those questions revolve around the goals themselves (Sugiawan *et al* 2023). Other questions pertain to how countries implement the SDGs (Nilsson *et al* 2017). On this latter point, countries may trade off the environment for other dimensions of development. There is nonetheless potential for countries to leverage synergies across or within the environmental and socioeconomic dimensions of the SDGs (Pradhan *et al* 2017, McCollum *et al* 2018, Breuer *et al* 2019, Kroll *et al* 2019). Such synergies entail meaningfully including segments of society such as women and youth in decisions related to the SDGs (Bowen *et al* 2017). Inclusion of these diverse perspectives could bring different values and fresh thinking to bear on relevant policies and practices. They could also build the coalitions needed to transform the energy, urban and social systems that often slow progress on the environment. It is, however, possible that the inclusion of these distinct voices may not be strong enough to break through inertias in the institutions, behaviors, and infrastructure that lock-in *status quo* systems (Unruh 2000, 2002, Foxon 2002, Seto *et al* 2016). Some studies have hence pointed to the possibility—but not the inevitability—that the inclusion of women or younger people in legislatures may trigger improvements in the environment.

2.2. Gender of legislators

Several studies underline the potential for female legislators to contribute to changes required for a healthier environment. Many grow from the ecofeminist literature that highlights a connection between women and nature, and underlines a predisposition

to environmentally-friendly attitudes and behavior (Dietz *et al* 2002, McKinney and Fulkerson 2015). According to arguments in this literature, this predisposition stems from mutually reinforcing values of patriarchy and capitalism that can lead to the exploitation of nature as well as women. Taking this line of reasoning further, cultural ecofeminists contend that women are naturally connected with nature because of their biological reproductive capabilities (Eisler 1990, Starhawk 1990). It is nevertheless worth noting that some contrary views suggest that women's identities are socially constructed and hence the notion of a women's 'essential nature' is a misnomer (Plumwood 1991, 1993, Alaimo 2000, Salleh 2017). A middle-ground view argues that the connection between women and nature are both biologically rooted and socially constructed (Hennessy and Ingraham 1997, Warren 2001).

There are also several studies that offer evidence of the inclination that underpins the eco-feminist logic. Studies on sustainability entrepreneurship point out that women-run businesses tend to be more motivated by social values whereas men tend to be driven by narrower economic interests (Hechavarria *et al* 2012, Pulido *et al* 2014). In a similar vein, some work also notes that women are inclined to be more responsive to the broader needs of local communities than men, implying a tendency to think about wider societal concerns, including the environment (Harding and Cowling 2006, Leahy and Villeneuve-Smith 2009).

While some arguments on the importance of gender underline that women may be more disposed to value the environment and support policies and programs consistent with this way of thinking, a related line of work points to the implications of those preferences on environmental problems and environmental agreements. Studies have, for instance, suggested that countries with higher proportions of women in parliament are more likely to ratify environmental treaties (Norgaard and York 2005). A comparable body of work has pointed to the implications of having a larger proportion of women in leadership positions for climate change. To illustrate, research on 70 mostly developed countries from 1990 to 2004 concluded that 14 countries that made the biggest reductions in CO_2 emissions had a higher proportion of women elected to parliament (UNDP 2007). A similar argument can be found in work that determined there was correlation between women with higher political status and fewer CO_2 emissions (Ergas and York 2012).

These findings have been extended to the non-governmental organizations (NGOs) and local governments. In terms of NGOs, research on 61 countries shows high levels of women's and environmental NGOs per capita are associated with lower rates of deforestation between 1990 and 2005 (Shandra *et al* 2008). Meanwhile at the local level, a higher number of female employers along with greater education expenditure and renewable energy consumption has helped reduce CO_2 emission in China (Zaman *et al* 2021). A comparable conclusion is drawn from work in the United States that finds that local governments led by women were more likely to have adopted redistributive programs and encourage community-based energy conservation (Homsy and Lambright 2021). Similar but more sector specific findings were discovered for women in transport planning in Sweden (Kronsell *et al* 2016).

It is nonetheless important to point out that questions exist about whether these results stem from having women in leadership roles or other factors driving these pro-environmental outcomes that are also correlated with gender equity. On this point, studies have argued that the observed association between gender and corruption is spurious–that is, it is mainly caused by contextual factors associated with a liberal democratic political system that promotes gender equality and better governance (Sung 2003). To illustrate, studies have argued that an egalitarian atmosphere and proportional representation system were among factors that enhance female representation in national parliaments (Paxton 1997, Reynolds 1999). Contextual factors like these influence women's behavior and condition them to work more actively on environmental issues. There may indeed be several interactions between social norms and environmental decisions. The article revisits this theme in the conclusion and takes care to avoid claims of a causal relationship between variables featured herein given these concerns. It is also possible that inclusion of women in legislatures may help but cannot alone transform unsustainable systems underlying climate change, species loss, and other wicked problems.

2.3. Age of legislators

Unlike the gender literature, studies on younger representatives in legislature and sustainability are limited in number and scope. However, connecting two areas of research suggest younger legislators may support environmental issues covered under the SDGs.

The first line of literature examines the relationship between age and environmental *concerns*. Some studies find younger people maintain stronger pro-environment values and policy preferences (Casey and Scott 2006). Others contend that longer life experiences dispose older people to hold such values and preferences (Gifford and Nilsson 2014). A third perspective is that neither youth nor longer life experiences are inherently conducive to pro-environmental attitudes. Rather belonging to a generational cohort when an environmental crisis occurred elicits such sentiments (Gray *et al* 2019). A final perspective comes from a revealing and nuanced study that looked at concerns of nearly 170 000 respondents to the World Values surveys from 1990 to 2009. That study concluded environmental concerns among young people in middle-income countries

have increased while 'stagnating or declining' in high-income countries. This divergence stems from differences in how education affects environment concerns for individuals in different income groups in more or less developed countries. In developed countries, environmental concerns only increase among younger people who become affluent and are well educated. In the same developed countries, less educated cohorts exhibit lower environment concerns as their incomes grows. In middle income countries, environmental concerns increase with greater individual affluence irrespective of education (Van-Heuvelen and Summers 2019).

The second line of literature outlines how environmental concerns among younger legislators are translated into policies. This set of studies suggest that some political systems elect younger representatives (Joshi 2013)–for example, proportional representation and lower candidate age (Gifford and Nilsson 2014) thresholds result in younger parliaments (Stockemer and Sundström 2018). Others maintain Western cultures are more likely to elect younger leaders than Eastern counterparts. Importantly, the same studies underline that cultural differences not only impact the average age but policies (Vaughan-Johnston *et al* 2021). These results are important because they imply a positive correlation between younger legislatures and performance on environmental issues featured in the SDGs.

Similar to the gender, there are some qualifications to the above work. One involves the logical links in the causal chain. More concretely, explanators such as democracy or social norms could lead to younger legislators who lead to performance on the SDGs. Another possibility foreshadows some of the conclusions that inclusion of new voices may not be sufficient to alter locked in systems.

3. Hypotheses, data and tests

3.1. Hypotheses

Based on the above literature, the article tests the following two hypotheses:

1. The more women in national legislatures and parliaments, the better the country's performance on the SDGs.
2. The younger the representation in national legislatures and parliaments, the better the country's performance on the SDGs.

By testing these hypotheses, this article aims to quantify the relationship between having more women and younger people in legislatures and performance on the SDGs. The article further considers the impacts of per capita gross domestic product (GDP), population size, and levels of democracy as control variables since previous studies suggest they correlate with SDG performance (and other development indices) (Sung 2003, Schmidt-Traub *et al* 2017). Because parliamentarians might have different impacts on environmental and socioeconomic SDGs, the article also examines the relationship between female and youth representation on different dimensions of the SDGs.

3.2. Data

One of the key explanatory variables in the model is age. The average age of the parliamentarians was estimated using the Inter-Parliamentary Union (IPU) Parline database (accessed in October 2022) for each country. Only the most recent parliament composition data were used, and the composition of both chambers was employed for countries with bicameral legislatures (having two houses). Average age ($\overline{X}$) was calculated as the sum of the number of individuals per age category (n_i) multiplied by the median age of each category ($\tilde{x}_i$) and divided by the total number of parliament member (N),

$$\overline{X} = \left(\sum_i (n_i \cdot \tilde{x}_i)\right) \Big/ N$$

Another key independent variable was the proportion of women in parliaments. This variable was measured by the percentage of women in the parliament as reported in the 2021 SDG index database.

The control variables in the model were the economic development, population size and the level of democracy. The first two variables were measured by extracting 2020 GDP per capita and 2021 population size from the World Development Indicators database (accessed in July 2021 and September 2022) and log-transformed to normalize their distributions and pull in skewed values as is commonly practiced in econometrics (Wooldridge 2009). The 2020 democracy matrix dataset (accessed in October 2022) was used to estimate the democracy (Lauth and Schlenkrich 2018).

Additional variables such as the six components of the World Governance Indicators (WGI), the Human Development Index (HDI), the Gini coefficients, the countries' surface area all (obtained from the World Bank's World Development Indicators), the parliaments' sizes, as well as existence of age and gender quotas (obtained from the International Institute for Democracy and Electoral Assistance Database) were accessed in October 2022 and used for the principal component analysis (PCA) (described later in the paper).

3.3. SDG performance

The dependent variable in the model is performance on the SDGs. To get a broadly comparable measure of performance, the article uses the 2021 SDG index from the SDSN and Bertelsmann Foundation (Sachs

2021). Since 2016, the index has been published annually to assess how close countries are to achieving the SDGs. The index is comprised of 120 indicators and gives equal weight to all the 17 SDGs, arriving at a score ranging from 0 (worst) to 100 (optimal) for each country. The index uses both official (accounting for 2/3 of all indicators) and unofficial data sources (accounting for 1/3) to compute that score. The index featured in this article was published in 2021, and covers 165 countries for which more than 80% of data was available. As the index has modified its methodology to address key data gaps over the years, it is not appropriate for time series analysis. The methodology of SDG index is peer reviewed and was audited by the European Commission Joint Research Centre in 2019.

Importantly, since the percentage of women's seats in the parliament is already part of the aggregate SDG index (included in the SDG 5 estimate) (Lafortune *et al* 2018) the article recalculated the SDG 5 score and the subsequent SDG index after excluding this variable. The modified SDG 5 score was calculated as the average score of five variables (demand for family planning satisfied by modern methods; ratio of female-to-male mean years of education received; ratio of female-to-male labor force participation rate; gender wage gap and gender gap in time spent doing unpaid work) following from Lafortune *et al* (2018). Modifying the SDG 5 score by removing the percentage of women's seats in the parliament leads to higher SDG 5 scores in 107 of 138 countries, reflecting the fact that many countries score poorly on women's seats in the parliament (supplementary figure 1(A)). The modified SDG index is the average score of the 17 SDGs (the modified goal 5 score and the original score for the 16 other goals). Also similar to Lafortune *et al* (2018), the article uses the average score of the region for countries where SDG 5 data were not available. When this modification of the SDG 5 score was considered to calculate the SDG index, this led to an increased SDG index in 86/138 countries (supplementary figure 1(b)). Yet this increase had a limited absolute effect of 2.3 points on the SDG index (which ranged from 41.7 to 85.6).

The other two dependent variables (namely the environmental SDG and socioeconomic SDG index) were calculated as the average of SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 12 (responsible consumption and production), SDG 13 (climate action), SDG 14 (life below water) and SDG 15 (life on land) scores and as the average of SDG 1 (no poverty), SDG 2 (zero hunger), SDG 3 (good health and well-being), SDG 4 (quality education), SDG 8 (decent work and economic growth), SDG 9 (industry, innovation and infrastructure), SDG 10 (reduced inequalities), SDG 11 (sustainable cities and communities), SDG 16 (peace, justice, and strong institutions) and the modified scores of SDG 5 (gender equality), respectively.

3.4. Statistical analyses

The next step was looking more closely at the relationship between key variables. To understand which explanators should be included in the model, the article performed a principal component analysis (PCA) of variables that might be correlated with the modified SDG index as well as the socioeconomic SDG index and the environmental SDG index. The PCA was performed on 19 variables (the modified SDG 5 score, the modified 2021 SDG index, the environmental SDG index, the socioeconomic SDG index, the age, gender and size of the parliaments, the GDP per capita, HDI, the Gini coefficient, the democracy matrix, the six components of the WGI, the country's population and area) where data was available for 101 countries. The variables used in the PCA were scaled and centered and the analysis was performed using the R ade4 package (Dray and Dufour 2007).

Three linear mixed effect models (Pinheiro and Bates 2000) were then used to quantify the relationship between the variables of interest. The three response variables were the modified 2021 SDG index, the environmental SDG index and the socioeconomic SDG index. For all three models, the percentage of women's seats in the parliament, the average age of the members of parliament, the democracy matrix index, the log-transformed GDP per capita and the log-transformed population size, and the interactions of these five variables were set as fixed effect variables; the economic-geographic regions (as defined by SDSN and Bertelsmann Foundation with the following modification: two non-Organisation for Economic Cooperation and Development (OECD) Oceanian countries—namely Fiji and Papua New Guinea—were merged with South and East Asia to ensure a sufficient group size) was set as random effect variables. The explanatory variables were selected based on the PCA results to minimize collinearity. To further reduce the number of explanatory variables, stepwise model selection was performed using Akaike Information Criterion (AIC) (Sakamoto *et al* 1986, Venables and Ripley 2002). The normality of the model residuals was confirmed by a *post hoc* Kolmogorov–Smirnov test ($D = 0.07$, $p = 0.31$) (Marsaglia *et al* 2003). Data used for the PCA and the regression analysis are available in supplementary table 1.

4. Results

4.1. SDG performance across regions

The modified 2021 SDG index and the socioeconomic index showed high interregional variability. The modified 2021 SDG index ranged from 79.1 ± 3.8 with an average $\pm$ standard deviation for OECD countries and 55.1 ± 5.8 for African countries. The average socioeconomic SDG index ranged from 84.5 ± 6.5 for the OECD to 47.3 ± 8.3 for Africa (figures 1(A) and (C)). At the same time, the

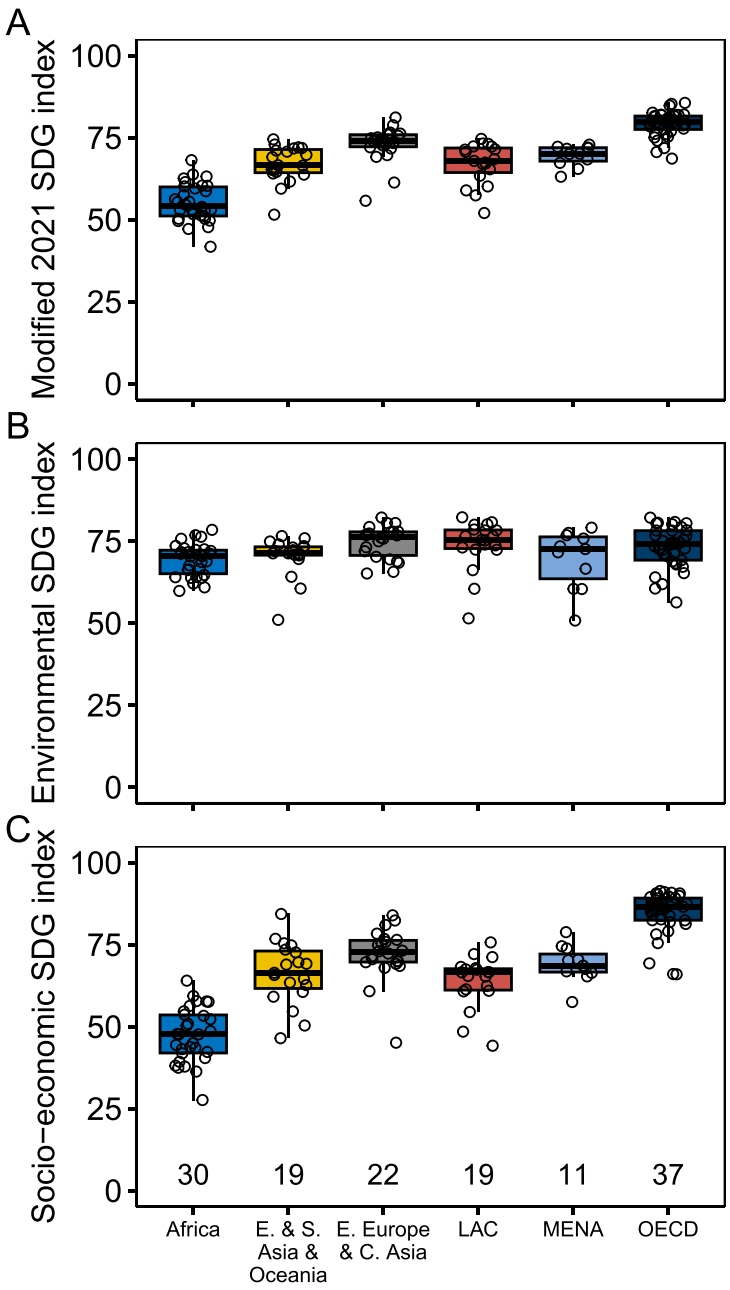

Figure 1. Regional differences in the distributions of the modified 2021 SDG index (A), the environmental SDG index (B) and the socioeconomic SDG index (C). For each boxplot, the lower and upper value hinges correspond to the first and third quartiles and the horizontal line corresponds to the median value. Whiskers extends from the hinge to the largest or smallest value no further than 1.5 times the inter-quartile range. The numbers in the bottom of panel C indicate the count of countries included in each region.

environmental SDG index was relatively consistent across the regions. That index ranged from 74.7 ± 4.9 in East Europe and Central Asia to 69.1 ± 4.9 in Africa (figure 1(B)).

4.2. Multivariate analysis

Results showed that the two first components of the PCA represented over 62% of the total variability of the dataset (respectively 50.9 and 12% for components 1 and 2; supplementary table 2). The modified 2021 SDG index, the modified SDG 5 score and the socioeconomic SDG index all had high loadings over the first axis (>0.7; figure 2(A), supplementary table 2), suggesting they were positively correlated with each other as well as the other variables with high loadings on the first component of the PCA (the GDP per capita, the democracy matrix, the six components of the WGI and the HDI). The second component of the PCA was dominated (loading >0.7; supplementary table 2) by size variables such as population, country surface area and parliament size.

Countries socioeconomic grouping showed higher values on the first axis for the OECD countries and high variability on the second axis for East and South Asia and Oceania (figure 2(B)). The different elective quotas were evenly distributed along the two

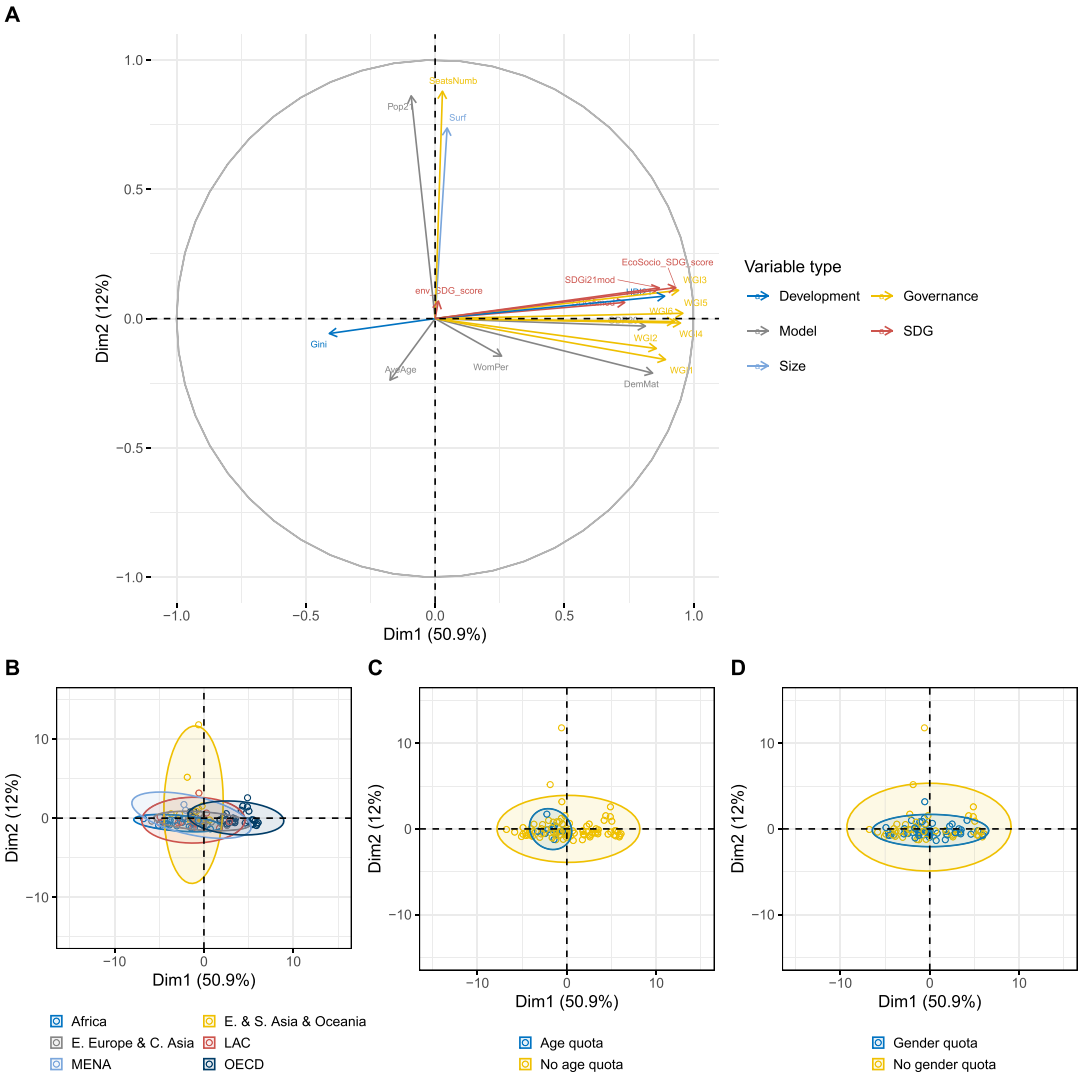

Figure 2. Distribution of the eigen values in the two first components of the PCA (A). Row coordinates grouped by socioeconomic regions (B), by the existence of elective age quota (C) and elective gender quota (D).

axes of the PCA (figures 2(C) and (D)), except for nine countries with an age quota, which exhibited low row coordinates on the first component (figure 2(C)).

Since many of the variables appeared to be correlated with each other (nine variables having high loading on the PCA axis 1), the article selected a limited number of explanatory variables to be included in the model so as to minimize collinearity. Hence, the article chose two explanatory variables having high loadings on the first axis of the PCA: per capita GDP and democracy. The article also chose one explanatory variable having high loading on the second axis of the PCA: population size. These control variables were analyzed in the model along with the percentage of women and average age of the parliaments (which had high loadings on the axes 5 and 6; supplementary table 2).

4.3. Linear models

Based on selection procedures that use the AIC, per capita GDP, age, women seats, democracy index and population size variables were chosen for inclusion in the model (table 1). Yet, the effect of population size on its own (outside of interactions) did not have a significant effect on the three response variables.

The age of parliamentarians and the percentage of women's seats had a significant effect on the modified 2021 SDG index and the socioeconomic SDG index ($F > 4.5$, $p < 0.04$, table 1). Gender and age predicted two-point increase on the modified SDG index—with an increase from 0%–61% of women's seats and a three-point decrease from average age of 36–67 (figure 3(A)). The modeling also predicted an increase from 66 to 71 in the socioeconomic SDG index from 0%–61% of the women's seat and a decrease from 72 to 66 from an average age 36–67 (figure 3(C)). Similarly, age had a negative effect on the environmental SDG index and women's seats had a positive effect (figure 3(B)); however, analysis of variance revealed these effects were not significant ($F < 0.1$, $p > 0.81$; table 1).

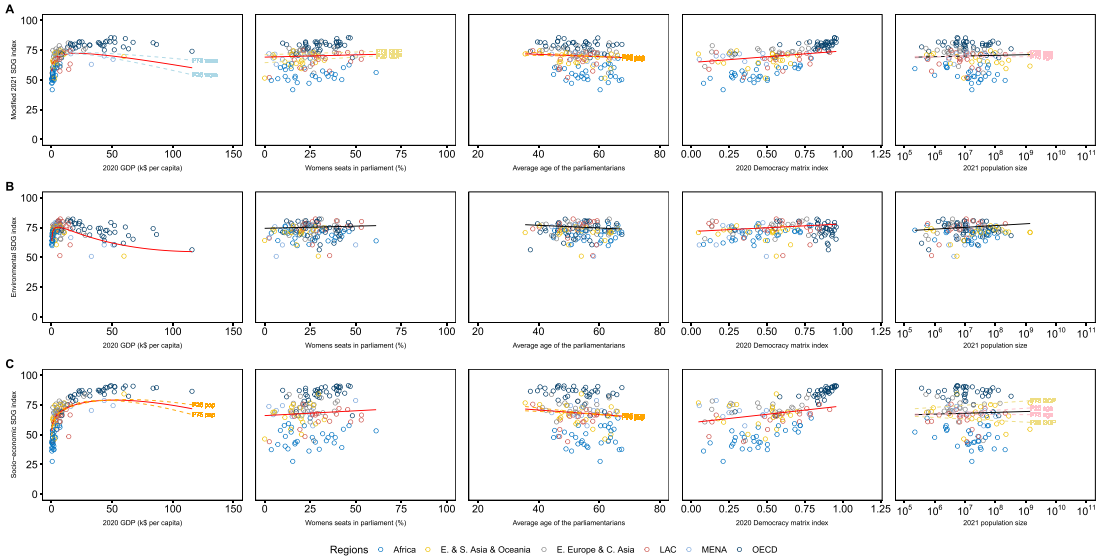

Figure 3. Outcome of the three models with the modified 2021 SDG index (A), the environmental SDG index (B) and the socioeconomic SDG index (C) as response variables. For each model, the article presents the effects of the 2020 GDP per capita (in k$ per capita), the percentage of women in the parliament, the average age of the parliament, the 2020 democracy matrix index, and the 2021 population size. Red lines indicate that the explanatory variable had a significant effect; black lines suggest the opposite. The lines were drawn using the model coefficients (table 1) and setting other explanatory variables to their medians. Dashed lines represent significant interactions and show the trends for the 25th (P25) and 75th percentiles (P75) of the interaction variable. The data points are color-coded by socioeconomic regions.

The effect of women's seat on the modified SDG index was mediated by GDP per capita (Women's seat * GDP per capita $F = 6.9$, $p = 0.01$, table 1) such that high-income countries (P75: GDP per capita = 18.8 k$ per capita) had a higher modified SDG index but in low-income countries (P25: GDP per capita = 2.3 k$ per capita) women's seat had an even stronger effect (as indicated by the larger slope, figure 3(A)). The negative effect of age on the socioeconomic SDG index was mediated by the country's population size (Average age * log (population size) $F = 7.2$, $p = 0.01$, table 1); a more populous countries experienced a steeper decrease in the socioeconomic SDG index (P75 = 41 million inhabitants) than less populous countries (P25 = 5 million inhabitants, figure 3(C)).

The democracy index had a significant effect on the three response variables (table 1). For instance, when the democracy variable increased from 0.05 to 0.96, the model predicted an increase in the index ranging from +6 for the environmental SDG index to +13 socioeconomic index (figure 3). GDP per capita also had a significant effect on the three response variables (table 1) with an overall positive effect on the modified SDG index (increasing from 57 to 72 in the 0.2–21.0 k$ per capita range and decreasing from 72 to 60 in the 21.0–116.0 k$ range; figure 3(A)) and the socioeconomic SDG index (increasing from 53 to 79 in the 0.2–52.0 k$ range and decreasing from 79 to 72 in the 52.0–116.0 k$ per capita range; figure 3(C)) while it negatively influenced the environmental SDG index (which increased from 64 to 75 in the 0.2–5 k$ per capita range then decreased to 55 for high income countries; figure 3(B)).

5. Policy implications and future research

The regression results suggest three notable findings. First, performance on the SDGs is correlated with gender, controlling for democracy, population and per capita GDP. Second, SDG performance is related to the age of legislators with the same controls. Third, the above results are weaker for the environmental than the socioeconomic dimensions of the SDGs. This section discusses the implications of these findings and outlines areas for future research.

5.1. Policy implications

For the first finding, the results point to possible gains from institutional reforms that bring more women into legislatures. These gains could be particularly sizable in developing countries. Realizing these gains could be achieved with shifts from majoritarian to proportional electoral systems (Carroll and Jenkins 2001, Norris 2006, Labonne *et al* 2021). Gender quotas may also hold similar promise given evidence of positive effects in contexts ranging from Kenyan villages (Ifejika Speranza and Bikketi 2018, Cook *et al* 2019) to Italian companies (Valls Martínez *et al* 2020, Marchini *et al* 2022). Deliberative mini publics in which representatives are randomly selected from diverse groups may also boost female participation (Fishkin 2009, Gül 2019) and offer an 'alternative formulation of deliberative democratic legitimacy

Table 1. Summary of the three linear mixed model analyses of variance showing the effect of the explanatory variables selected on the modified 2021 SDG index, the environmental SDG index and the socioeconomic SDG index and the estimations of the model coefficients. Significant variables (p-value <0.05) are in bold. For each model, *LogLik* indicates the log likelihood, *df* the degrees of freedom, *Sigma* the residual standard deviation, *AIC* the Akaike information criterion and R^2 the model's coefficient of determination.

		Analysis of variance				Model coefficients				
Response variable	Explanatory variable	numDF	denDF	*F*-value	*p*-value	Value	Std.Error	DF	*t*-value	*p*-value
Modified 2021 SDG index	Intercept	1	120	1286.9	<0.01	25.20	23.7	120	1.1	0.29
LogLik = −382;	**Average age**	1	120	4.5	**0.04**	0.46	0.4	120	1.1	0.29
df = 15;	**Women's seats**	1	120	12.0	**<0.01**	−0.26	0.2	120	−1.1	0.28
Sigma = 3.57;	**log(GDP)**	1	120	56.3	**<0.01**	0.14	3.0	120	0.0	0.96
AIC = 794.01;	**GDP**	1	120	23.2	**<0.01**	−0.01	0.2	120	0.0	0.97
R^2 *= 0.86*	**Democracy index**	1	120	23.0	**<0.01**	9.71	2.0	120	5.0	<0.01
	log(Population size)	1	120	0.4	0.53	3.30	1.4	120	2.4	0.02
	Average age * Women's seats	1	120	3.1	0.08	0.01	0.0	120	1.8	0.07
	Average age * log(GDP)	1	120	1.1	0.29	0.12	0.1	120	2.1	0.04
	Average age * GDP	1	120	1.8	0.19	−0.01	0.0	120	−2.4	0.02
	Average age * log(Population size)	1	120	4.4	**0.04**	−0.06	0.0	120	−2.2	0.03
	Women's seats * log(GDP)	1	120	0.0	0.91	−0.09	0.0	120	−2.3	0.02
	Women's seats * GDP	1	120	6.9	**0.01**	0.01	0.0	120	2.6	0.01
Environmental SDG index	Intercept	1	124	5042.4	<0.01	64.82	6.2	124	10.4	<0.01
LogLik = −415.81;	Average age	1	124	0.0	0.97	−0.11	0.1	124	−1.9	0.07
df = 11;	Women's seats	1	124	0.1	0.81	0.02	0.0	124	0.4	0.72
Sigma = 4.75;	**log(GDP)**	1	124	7.5	**0.01**	5.68	1.2	124	4.6	<0.01
AIC = 853.63;	**GDP**	1	124	50.2	**<0.01**	−2.04	0.5	124	−4.5	<0.01
R^2 *= 0.43*	**Democracy index**	1	124	6.0	**0.02**	6.41	2.5	124	2.6	0.01
	log(Population size)	1	124	3.6	0.06	0.65	0.3	124	2.3	0.02
	Women's seats * GDP	1	124	3.1	0.08	0.003	0.0	124	1.5	0.13
	log(GDP) * GDP	1	124	13.5	**<0.01**	0.33	0.1	124	3.7	<0.01
Socio-economic SDG index	Intercept	1	117	708.1	<0.01	0.98	34.4	117	0.0	0.98
LogLik = −413.48;	**Average age**	1	117	8.5	**<0.01**	0.88	0.6	117	1.5	0.14
df = 18;	**Women's seats**	1	117	20.4	**<0.01**	0.99	0.5	117	2.1	0.04
Sigma = 4.48;	**log(GDP)**	1	117	165.4	**<0.01**	−18.34	8.9	117	−2.1	0.04
AIC = 862.97;	GDP	1	117	3.1	0.08	1.94	0.9	117	2.1	0.03
R^2 *= 0.91*	**Democracy index**	1	117	21.2	**<0.01**	20.22	5.1	117	3.9	<0.01
	log(Population size)	1	117	0.0	0.86	3.63	2.0	117	1.8	0.07
	Average age * log(GDP)	1	117	3.4	0.07	0.09	0.0	117	1.9	0.06
	Average age * log(Population size)	1	117	7.2	**0.01**	−0.08	0.0	117	−2.2	0.03
	Women's seats * log(GDP)	1	117	3.0	0.09	−0.10	0.1	117	−2.0	0.04
	Women's seats * GDP	1	117	2.2	0.14	0.01	0.0	117	1.5	0.14
	Women's seats * Democracy index	1	117	2.6	0.11	−0.24	0.2	117	−1.5	0.14
	Women's seats * log(Population size)	1	117	0.9	0.33	−0.04	0.0	117	−1.4	0.18
	log(GDP) * GDP	1	117	0.2	0.66	−0.20	0.1	117	−1.8	0.07
	log(GDP) * log(Population size)	1	117	0.8	0.37	1.20	0.5	117	2.6	0.01
	GDP * log(Population size)	1	117	6.1	**0.01**	−0.07	0.0	117	−2.5	0.01

that does not rest on an electoral moment' (Setälä and Smith 2018). In the above cases, the quality not just the quantity of participation matter (Arora-Jonsson 2014). Moving away from *pro-forma* tokenistic engagement (Prokopy, 2004, Hannah *et al* 2021) to genuine organic consensus building (Grillos 2021) can improve the quality of participation. It may also help balance power dynamics that can less perceptibly but critically undermine progress on issues covered under the SDGs—especially given the relatively stronger relationships between gender and SDG performance in developing countries (Bee and Sijapati Basnett 2016).

For the second finding, the results underline the potential of institutional reforms that bring younger people into legislatures. The implications parallel those involving gender. For instance, they suggest the possible promise of incumbent term limits or youth quotas to lower the average ages of representatives (Stockemer and Sundström 2018). Similar to the above, these efforts are likely to be most significant in developing countries. They may also imply, along with the first finding, the need for representation of many diverse groups not simply women and/or younger people in decision-making bodies.

For the final finding, the links between more female and younger legislative representation and the environmental SDGs are weaker than the socioeconomic SDGs. This is indicated by the modeling outputs suggesting the women's seats and age variables should be kept in the model, though their individual effects are not statistically significant. To some extent, this finding needs to be qualified by the fact that several environmental indicators are part of the socioeconomic SDG index (e.g. an indicator on air pollution is under SDG 3 on health), making disentangling the two dimensions challenging. At the same time, the finding raises a critical question: why are

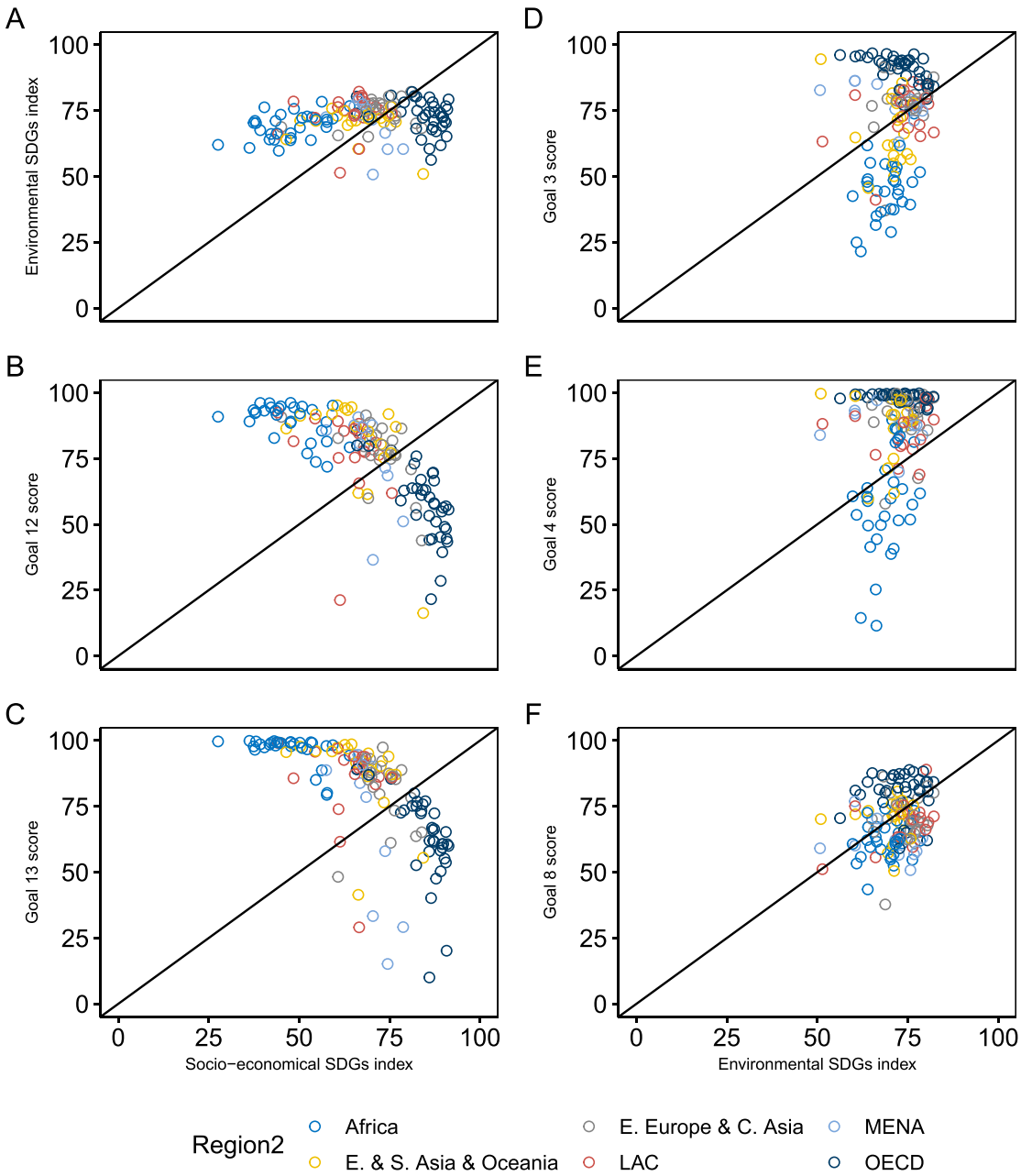

Figure 4. Scatterplots of the environmental SDG index (A), Goal 12 score (B), Goal 13 score (C) vs the socio-economical SDG index and Goal 3 score (D), Goal 4 score (E), Goal 8 score (F) vs the environmental SDG score. Solid line is the identity line. Countries are grouped and color-coded by socioeconomic regions.

youth and gender variables not more strongly correlated with performance on the environmental SDGs?

This result is arguably attributable to features of the data and their underlying interrelationships. One feature is that the variance in the environmental dimensions is much smaller than the socioeconomic SDGs. A ceiling on the environmental SDG index values reduces the variation that can be explained in this variable. A related feature—and part of the reason for the limited variance—is that per capita GDP is negatively correlated with the environmental SDGs. Developed countries perform worse on many of the environmental SDGs, possibly suppressing the values of this variable. This suppression suggests that developed countries are often trading off the environment for other dimensions of development. This tendency—illustrated clearly in the bivariate scatterplots of socioeconomic development on SDG 12 (responsible production and consumption) and 13 (climate action)—(figures 4(A)–(C)) may suggest systemic constraints in energy and consumption and production systems that even more representative legislatures are unable to overcome.

The above inference implies that recommended institutional reforms (i.e. gender quotas and deliberative mini publics) can help but cannot improve the environment alone. To some extent, they will need to be combined with policies that work at

the intersection of social and environmental dimensions to translate trade-offs into synergies (Kroll *et al* 2019). The potential for synergies may be particularly great between the environmental SDGs and SDG 3 (good health and well-being), 4 (quality education), 8 (decent work and economic growth) as illustrated in the bivariate scatterplots in figures 4(D)–(F). Specific synergistic proposals that work at this intersection could include legislation promoting just transitions that go beyond the important albeit narrow focus on reskilling laid-off fossil fuel (McCauley and Heffron 2018) to empowering different social groups to transform energy, food, and production and consumption systems (Lee and Zusman 2019, Han and Ahn 2020). Packaging policies that boost funding for climate change education and programs that promote sustainable living and life-long learning similarly aim to leverage synergies (Becker 2018, Monroe *et al* 2019). Finally, proposals that seek to improve planetary health at the same time as they safeguard societal well-being also work at the intersection of health and environmental concerns (de Paula *et al* 2021, Williams *et al* 2021).

5.2. Future research

While the paper has several policy implications, it also suggests areas for further research.

One revealing area involving policymaking institutions outside of legislatures such as bureaucracies. Looking more closely at bureaucracies may prove revealing since they tend to be more insulated from the political and interest group pressures that can lead to a tendency to put growth before the environment. Research examining interagency arrangements that directly influence SDG performance, such as horizontal or vertical coordination mechanisms, can offer these insights. Exploring this relationship could involve constructing a broadly comparative metric for differentiating bureaucracies to conduct a large-*n* study like the one in this article. It may also be possible with carefully constructed case studies.

Another useful area for further study is a longer-term perspective. Even if women and youth in the legislature contribute to environmentally sustainable policies, environmental changes are almost by definition long-term; it could take close to decade to see changes in these dimensions.

Preliminary time lag analysis shows that the past parliament composition influences the current SDG performance in a similar way as the current parliament composition, suggesting that time lag effect is very low (see supplementary information). However, given the possibility that such effects may take more than ten years to become visible, it is still early to examine change over time on the environmental SDGs.

A final set of questions meriting additional study pertains to causality. That is, is there a causal relationship between legislative representativeness and SDGs performance? A quantitative approach to do this could use regression models to examine links between representation of women and youth at local decision-making bodies and local level SDGs performance. This approach controls norms and cultures as they are largely consistent within a country. A qualitative approach may include conducting interviews and case studies to identify how politicians have influenced sustainability policies and outcomes over time. These studies may uncover pathways through which sustainability policies and outcomes are generated. In so doing, they will offer useful insights into how political systems affect whether countries are living within or transgressing planetary boundaries.

Data availability statement

All data that support the findings of this study are included within the article (and any supplementary files).

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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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