Population and Environment (2023) 45:13
https://doi.org/10.1007/s11111-023-00425-4

ORIGINAL PAPER

The influence of population aging on global climate policy

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Accepted: 19 June 2023

Abstract
We study the connection between the demographic transition to an aging population and global climate policy ambition in the outcomes from recent international agreements on climate change: We test whether the share of the elderly in a population is a significant determinant of the quantity and ambition of a country's policy actions against climate change. We use different indicators of climate policy ambition as measured by the Nationally Determined Contributions (NDC) of the Paris Agreement as updated in the Glasgow Climate Pact. We also use the number of climate change laws passed in a country to further test robustness of main results. We resort to instrumental variables as part of our identification strategy to account for potential endogeneity. Our econometric results indicate a negative association between the share of the elderly and both policy ambition in climate agreements and the intensity of regulatory initiatives to fight climate change. This suggests that the increasing political influence of the older population as a consequence of aging hinders climate policy ambition. Policy implications are discussed.

Keywords Climate policy · COP26 · Paris agreement · NDCs · Population aging

Introduction

The 2021 United Nations Climate Change Conference held in Glasgow, referred to as COP26, was the first conference since the Paris Agreement where pledge-and-review system, instituted in Paris, was to be tested. By means of the so-called nationally determined contributions (NDCs), the Paris Agreement contains a mechanism that requires countries to pledge their long-term reductions in GHG emissions. In an effort at ratcheting up both individual and aggregate ambition, parties are required to update their NDCs every five years. Postponed one year because of the pandemic, the Glasgow climate conference expected parties to update their NDCs,

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Published online: 06 July 2023

as many did. In this context, this paper asks about how countries' climate policy ambition, as measured by their NDC pledges right after COP26, is influenced by today's population ageing, increasingly important and gaining political influence in many countries.

The 2015 Paris Agreement adhered to by 196 parties and aimed to limit the increase in global warming to below 2 °C above pre-industrial levels is, however, dependent on a bottom-up architecture; meaning that its success rests on countries' voluntary mitigation actions and the extent of their own ambition. Countries are free to set their own national goals and are only accountable in terms of achieving those targets. The degree of ambition shown and willingness to act – in terms of the implementation of more stringent or more relaxed policies – varies considerably across countries and over time.

This disparity comes in part because countries conceptualize equity in effort-sharing differently, and determine their pledges accordingly. At the same time, many other factors have been found to influence these cross-country differences in climate action: most notably, public opposition and lack of commitment on the part of citizens (Lachapelle et al., 2012; Pearson, 1995), political trust and beliefs (Fairbrother et al., 2019; Klenert et al., 2018), political polarization (Hornsey et al., 2016), social norms and social capital (Bergquist et al., 2019; Hao et al., 2020) and sociodemographic characteristics that include gender, race, education, and income (see Ballew et al., 2020 and Lewis et al., 2018 for a meta-analysis). In the present context of seeking to ratchet up aggregate ambition, the NDC mechanism provides an interesting opportunity to examine the specific determinants of domestic climate change efforts.

In this paper, we are interested in identifying the role that population aging, as it is measured by the share of elder population in a country, plays in explaining cross-country differences in the critical enhancement of climate policy ambition. We explore whether aging is responsible for cross-country variations in the ambition of national climate change mitigation actions. Specifically, we test whether a country's climate ambition is positively or negatively affected by the demographic age structure of its population. This question can be considered critical because in aging societies, the attitudes and support of the elderly have grown in relevance, establishing themselves as an influential political factor in many areas. It is, therefore, reasonable to expect the demographic age structure to play a role in climate policy, especially considering the shorter time horizons of aging populations and the fact that climate change costs accrue in the future.

To quantify climate policy ambition, we use three different sets of metrics, so as to better capture the diversity of dimensions involved in current climate actions (Aldy & Pizer, 2016). First, we use the predicted change in the 2019 to 2030 per capita emissions according to the updated NDCs (Meinshausen et al., 2022). Second, we adopt a more normative approach by using the NDC warming index developed by Robiuou du Pont and Meinshausen (2018). These authors estimate a temperature-based metric that indicates the degree of global warming associated with each country's NDC pledge if all countries adhere to the same equity principle. This provides us with a measure of a country's climate effort as measured from the perspective of each country. Finally, we use the number of climate change laws enacted across countries (adjusted for lifetime and the quality of the rule of law) as a measure of regulatory initiatives to fight climate change (Eskander et al., 2021).

As an indicator of a country's share of elderly, we use the percentage of population aged over 65 as a baseline, although we also provide robust evidence for alternative definitions so as to account for countries' heterogeneity. To address potential endogeneity issues, we instrument the elderly share using the share of women (limited to countries with shares near 50%), the cardiovascular death rate and the prevalence of smoking, all of them significantly associated with a higher aged population but allegedly uncorrelated with national climate policies. This allows for a net identification and potentially causal interpretation of coefficients. As country age structure is found to be endogenous, our instrumental variable strategy proves to be critical in disentangling this relationship.

Our results show that an aging population reduces climate policy ambition: specifically, a 1% higher share in elderly population contributes to a 2% increase in the NDC prediction of per capita emissions in 2030. This corresponds to a 0.28 °C rise in the NDC warming index and five fewer climate change laws (quality and lifetime adjusted). We find these results are robust to alternative specifications, instruments and definitions of elderly population.

According to recent evidence from survey data, this outcome might reflect the fact that older generations are less concerned about climate change, less likely to allocate public funds for environmental purposes, and less inclined to support climate policies (Ziegler, 2017; Andor et al., 2018; Hao et al., 2020) such as fossil fuel taxes (Fairbrother et al., 2019). Although the elderly do not seem any more likely to deny climate change, they are more likely to note the lack of scientific consensus (McCright & Dunlap, 2011) and to show greater skepticism than other age groups (Andor et al., 2018; Poortinga et al., 2011; Whitmarsh, 2011). Indeed, Bohr (2017) has reported an inverted U-shaped correlation between age and climate change skepticism, although others, including Tranter and Booth (2015), have found that age is not a particularly consistent international predictor of climate change skepticism.

Thus, a large body of literature connects population aging with different forms of climate change concerns. However, it should be stressed that these relate solely to public opinion issues and not to actual climate policy implementation. Here, however, we contribute to the literature by providing the first empirical evidence on how the age divide – particularly, that is, the preferences and beliefs of the elderly – shapes actual climate policy ambition. In so doing, we help relate age-related climate attitudes to actual climate policy making and their impact on the global climate policy arena.

Based on these findings, we discuss the fit between theories that predict the behavior of the elderly with respect to the challenges posed by global warming. Specifically, we examine the theory that predicts lower rates of support among the elderly due to their time horizon and different discounting rates on the timing and distribution of costs and benefits – the 'selfish' explanation. We also consider the 'legacy' or 'altruistic' explanation, which predicts precisely the opposite, positing that the elderly are natural allies of climate policies due to their concerns regarding the welfare of future generations and the future of the Earth they will leave behind.

The remainder of the paper is organized as follows. The next section discusses the relationship between aging and climate change and presents the main theoretical framework underpinning the hypothesis tested in this study. Section "Data" explains our empirical strategy, describing the data, variables, and methods employed. Our results are presented in Section "Empirical strategy" and their implications are discussed in Section "Robustness checks". Section "Conclusion and policy implications" concludes the paper.

Aging and climate policy support and adoption

Research linking aging with climate change has, to date, been focused mainly on the fact that, among the different demographic groups, it is the elderly that are most at risk from the effects of climate change. Harper (2019) has explored the problems associated with the convergence of the challenges posed by climate change and aging, concluding that the oldest age group are at higher risk during episodes of drought, heat waves, floods, hurricanes, and snow storms, and that they can be expected to be particularly affected because their long-term exposure, comorbidities, and frailty increase cumulative associations between pollution and lung function. Watts et al. (2021) found that the population aged over 65 years old was among the groups worst affected by exposure to high temperatures and heatwaves. They observed a 54% increase over the last 20 years in heat-related mortality in this age group worldwide. In addition, the vulnerability of the elderly is further increased by their limited ability to make seasonal or long-term migratory moves to escape the effects of heat and flooding (see Wang et al., 2020 for seasonal migrations), particularly in coastal areas.

Political implications of aging and attitudes toward climate change action

As a result of population aging, the voting behavior of the elderly has become increasingly important in democracies. As this age group begins to account for a larger share of the population, their voting behavior can be expected to receive increasing attention and, moreover, the aging of the median voter may have consequences for the provision of public goods (Downs, 1957). Indeed, their influence on public policy is likely to be reinforced by aging and also by their greater participation in electoral processes than that of their younger counterparts (Binstock, 2006; Bussolo et al., 2015).

Several reasons have been forwarded to explain the higher propensity of older people to vote. The probability of performing a specific behavior tends to increase with the past frequency of that same behavior (Ajzen, 2002); thus, the residual effect of voting increases the future probability of turning out to vote. As Goerres (2007) suggests, the elderly have grown accustomed to voting in the course of their lives, which strengthens a subjective norm to vote as a pattern of social behavior. This higher propensity to vote, combined with their vulnerability described above, might imply greater support among the elderly for ambitious climate change policies. Indeed, in addition to their associated health concerns, it has been suggested that the elderly are allies of climate action. What is more, several studies have provided evidence of a positive association between age and altruism (Feldstein & Taylor, 1976; List, 2004), and the explanation based on "legacy or altruistic thinking" predicts that the elderly become allies of action against climate change because they care about the welfare of future generations and their own legacy (Frumkin et al., 2012), in what is a clear example of altruistic behavior.

Yet most of the evidence points in the opposite direction, with significant reasons having been identified that tend to reduce the involvement of the elderly in these efforts. Thus, Andor et al. (2018) have argued that climate change actions are characterized by short-term costs and uncertain long-term benefits, which might find particularly weak support from the elderly because their individual planning horizons may be rather short. A shorter life expectancy is associated with choices that reveal a higher discounting of the future (Oster et al., 2013), and Huffman et al. (2019) have found that time discount rates increase with age. This evidence is consistent with findings that the decrease in cognitive ability because of aging is associated with more marked impatience (Dohmen et al., 2010) and, therefore, less willingness to wait for delayed gratification (Sunde & Dohmen, 2016).

Indeed, the different cost–benefit discount rate of the elderly with respect to that of other age groups has become a standard explanation for the lower responsiveness and involvement of the older population in action against climate change. Even if the elderly were to become the group worst affected by climate change, it would not be those in the present older population who suffered the full cost, but rather their younger fellow citizens. Instead, current older generations would bear a significant part of the costs of present climate action seeking to mitigate future costs.

Recent empirical studies of older people's public policy spending preferences have yielded interesting insights, generally indicating that the elderly prefer public spending on policies that directly benefit older people, while giving lower preference to spending on policies that do not directly benefit them. In a sample from 14 OECD countries, Busemeyer et al. (2009) found a lower preference for spending on education and a higher preference for spending on pensions, and these preferences were unrelated to cohort effects. Again, in a sample from 22 countries, Sørensen (2013) found evidence that older population groups show a lower preference for education and a higher preference for spending on pensions and healthcare. Furthermore, these differential preferences remained significant when cohort effects were controlled for, and were unrelated to ideological divides (typically, the right-left divide).

In a more recent study, De Mello et al. (2017) analyzed data for countries all over Europe plus those of the former Soviet Union (thus including developed, middle income, and developing countries in their sample), and, like Sørensen (2013), disentangled aging and cohort effects. They found that older people showed a greater preference for public expenditure on pensions and healthcare, and a lower preference for public expenditure on education. Furthermore, the probability of giving priority to policies aimed at protecting the environment decreased with age, when controlling for cohort effects.

Generational divide regarding environmental policies: Evidence from recent surveys

A recent Gallup survey (Reinhart, 2018) in the US shows a 14 percentage points difference between those aged 18 to 34 cohort and the over 55 s in how worried each is, respectively, about global warming (70% vs. 56%). Thus, even though public concern exists in all age cohorts, it differs markedly by age, with the biggest generational gap occurring in the belief that global warming will pose a serious threat in one's own lifetime. This gap is reasonable and fits well with the prospects of future costs of global warming. However, the second biggest generational gap occurs in the belief that global warming is caused by human activities (see Reinhart, 2018). In Europe, although Europeans are generally more concerned about climate change and more supportive of policy action, a recent survey by the European Investment Bank (2020) shows that 20% of the population over the age of 60 does not believe it to be a human-led phenomenon, with a 7–8 percentage point gap with respect to the youngest groups (15–29). This may serve to explain why this appears to be the group which believes least in the impact of personal behavior. Furthermore, this is also the group of respondents that most frequently reports that climate change has not affected their daily lives.

A recent Eurobarometer survey (European Commission, 2019) also found differences – albeit small – in opinion by age group. For example, climate change is the single most serious problem facing the world according to 26% of the youngest cohort (15–24), 24% of the second youngest cohort (25–39), and 21% of the oldest cohort (+55). Most respondents believed that the challenge should be addressed by national governments, businesses and industries, and the European Union, and about one third also thought that the challenge should be tackled by changes in personal behavior. In this respect, 59% of the oldest cohort reported having taken action, a slightly lower percentage than in the 25–39 and 40–54 cohorts (61 and 64%, respectively). Respondents aged over 55 did not lead any of the action groups considered in the survey, but ranked second in trying to reduce waste and energy and fuel consumption. In addition, they seemed to be concerned about the carbon footprint of their food purchases. In contrast, they reported relatively less engagement in other actions, including regular use of environmentally friendly transport alternatives (particularly in comparison with the youngest cohort: 33% vs. 42%, respectively), buying lower energy consumption household appliances, and switching to renewable energy suppliers.

When asked about their beliefs, this was the group that believed least in the following statements: (1) Climate policies will lead to innovation and competitiveness, (2) reducing fossil imports will increase energy security and benefit the EU economically, (3) promoting cleaner technologies in countries outside the EU may benefit the EU, and (4) adapting to the adverse impacts of climate change can have positive outcomes for citizens. In terms of policy action, this was also the group that showed least support for public funding programs for clean energies and the reduction of subsidies to fossil fuels.

Some authors, however, warn that this generational gap might not be associated with population aging, but rather with a cohort effect. Generational effects can exist for various reasons, including, for example, long-term processes involving changing social values among younger cohorts (Danigelis & Cutler, 1991; Tilley, 2002, 2005). Different aging cohorts are influenced by their own experiences and each elderly cohort might adopt different approaches over time to climate change policies. Thus, younger cohorts that are more concerned about climate change and global warming may change their beliefs, attitudes, and preferences as they age. If this is true, then the generational gaps identified would reflect temporary differences.

Nonetheless, studies of the factors that explain a higher frequency of support for conservative electoral platforms among the elderly have found the effect of age to be significant in the UK, even after controlling for cohort effects (Tilley & Evans, 2014); More recent empirical studies on political and electoral behavior show that -with age- the shift from progressive to conservative is more frequent than vice versa in the US (Peterson et al, 2020), that shifting towards conservative parties occurs at an older age than shifting towards progressive parties in Norway (Geys et al, 2022), and that younger people held stronger pro-climate attitudes than older people in the 2019 Australian election (Colvin & Jotzo, 2021).

Existing evidence on the relationship between age and political and electoral behavior is in line with the findings reported by Sørensen (2013) and De Mello et al. (2017) on age-related preferences for public spending and prioritization of public policies. It is worth recalling here Goerres's (2007: 96) proposal that generational effects are more influential in age effects that depend on national context, while individual aging exerts a stronger influence on age effects that stem from universal values. This is consistent with empirical studies showing stronger generational effects in single country studies (e.g., Feldstein & Taylor, 1976; List, 2004) and stronger aging effects in cross-country studies (e.g., De Mello et al., 2017; Sørensen, 2013).

A literature review in related domains and topics indicates that older people give greater priority to policies that have a direct impact on their lives, such as pensions and healthcare, and assign a lower priority to policies that either do not benefit them directly or which have a long-term benefit, such as environmental protection. Furthermore, older people tend to vote more than younger people. Therefore, older people's policy preferences and high electoral participation will influence political agendas and shape governments' policy priorities and public interventions. From this we derive the key hypothesis for our empirical exercise:

H1: An aging population is negatively related to the ambition of national policy actions against climate change.

Data

Measuring the degree of a country's ambition in relation to climate policy is challenging and yet the Paris Agreement is built on the principle of enhancing climate policy ambition in order to ensure the highest possible mitigation efforts (UNFCCC, 2015). To assess the extent to which the elderly affect a country's climate policy ambition, we use three measures. The first is based on the targeted future emission reductions per capita derived from the updated NDC pledges as of 11 November 2021, after COP26 (Meinshausen et al., 2022). Many countries submitted two

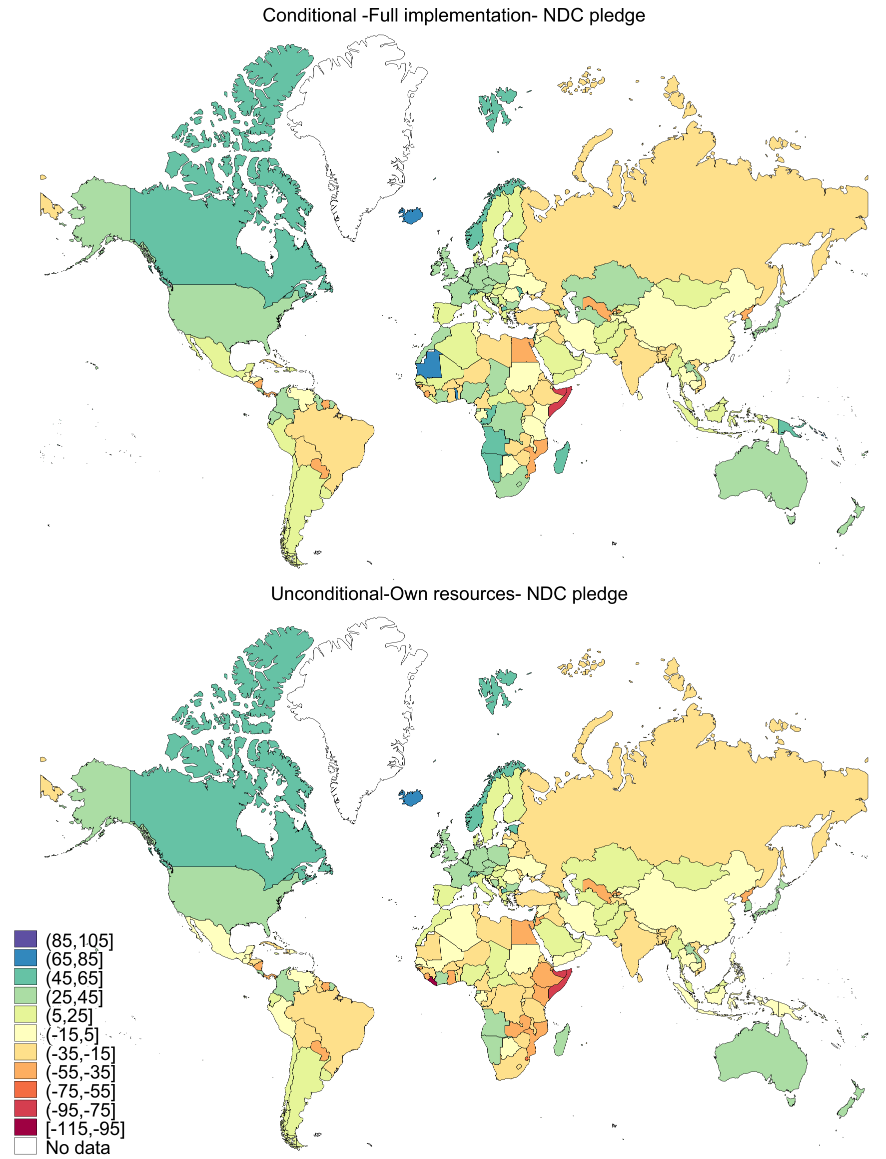

Fig. 1 NDC unconditional and conditional pledges as a percentage change of emissions per capita between 2019 and 2030

different pledges: an unconditional, less ambitious, pledge dependent on a country's own resources and capabilities, and a conditional, more ambitious, pledge dependent on the receipt of external aid, on the understanding that the country requires external financial, technological, or capacity-building resources. Figure 1 shows the reduction commitments of these two respective NDC pledges as a percentage change of emissions per capita between 2019 and 2030. Thus, for instance, South Africa pledges a 32% reduction in its 2019 per capita emissions if external aid is received (pale greener color), while it commits itself to an increase of no more than 12% if such support is not forthcoming (pale orange). Although this first measure is arguably a defining indicator of climate policy ambition, it may fail to capture a number of idiosyncratic elements of a country: that is, the same targeted reduction per capita may hide different efforts and costs across countries.

For this reason, the second climate policy ambition measure we use is based on a more normative perspective of global effort sharing, after all, one of the main barriers to a consistent global climate policy is how to operationalize “common but differentiated responsibilities”. The Paris Agreement addressed this issue by implementing a bottom-up architecture, whereby countries pledge their own national contributions to global mitigation. Importantly, these emission reductions are undertaken on the basis of equity. However, individual NDCs align with quite divergent concepts of equity, which may result in an emissions overshoot by 2100. Robiou du Pont and Meinshausen (2018) exploit these different concepts of equity to construct a warming metric of NDC pledges that shows the global warming impact of each country’s NDC if all countries show the same degree of ambition (equity concept) as that of a given NDC. Their key assumption is that each country adopts a self-interested approach by following the least-stringent – highest cumulative emissions in 2100 – of the different effort sharing approaches.[1] Thus, for example, the USA or China’s NDCs would be consistent with a global warming of 4 and 5.1 ºC, respectively. The NDC warming measure (Fig. 2) ranges from 1.2 °C (most ambitious) to 5.1 °C (least ambitious).

Finally, our third climate policy ambition measure relies on a more practical approach: Emission pledges are more credible when they are rooted in law. Here, we measure climate policy ambition by counting the number of legislative and executive climate change laws adopted in each country (Eskander et al., 2021). Although climate laws may vary greatly in scope and ambition, the number of laws passed is still an important indicator of a country’s climate policy ambition in its extensive margin. However, in the intensive margin, the number of laws a country passes will not account for differences in national legislative approaches: an overarching piece of legislation in one country may cover as much as several separate interventions in another. Consequently, Eskander et al. (2021) provide two adjusted measures of climate laws, one adjusted for their quality and potential effectiveness – using the rule of law variable from the Worldwide Governance Indicators (Kaufman et al., 2010)[2] – and another further adjusted by factoring in the number of years since the law was implemented. For instance, in the period 1990–2018, Spain passed 38 climate change laws to the UK’s 20. However, when adjusted for the rule

[1] The metric combines three equity principles: capability to pay (countries with a high per capita GDP receive lower emission allocations), historical responsibility (the higher a country’s cumulative emissions, the lower the emissions allocation) and emissions equality (convergence in current emissions).

[2] The rule of law variable used to adjust the number of Climate laws captures “perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the court” (Kaufman et al., 2010).

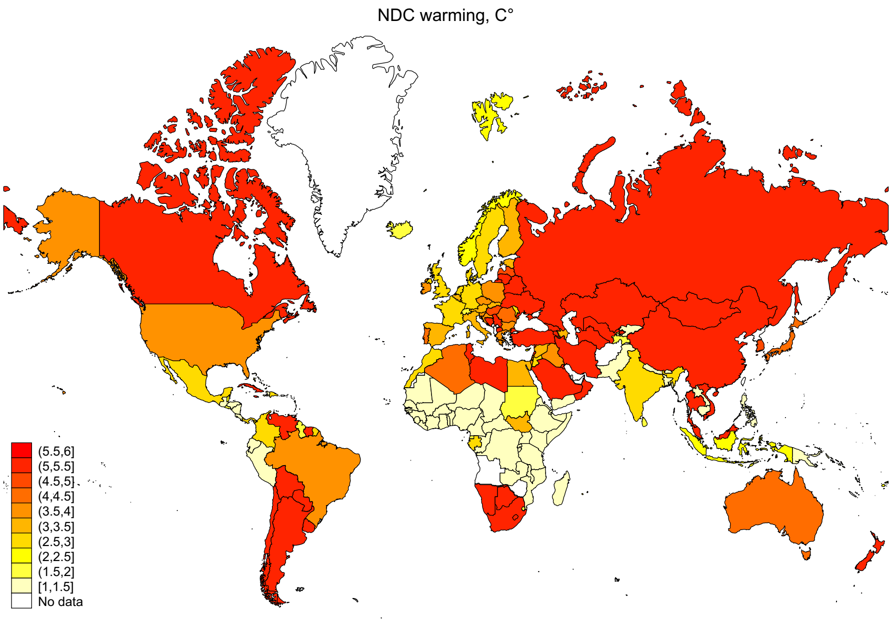

Fig. 2 NDC Warming pledges according to Robiou du Pont and Meinshausen (2018)

of law index, Spain had 27 quality-adjusted laws while the UK had 16. Furthermore, when multiplying by the number of years each law has been in force respectively, we find that Spain had 234 law-years on climate change and the UK 209. As is evident, the differences between the two countries are less pronounced when considering these adjustments (Fig. 8 in the appendix shows the map distribution for these climate policy ambition measures).

In all cases, we use cross-country regressions where our main explanatory variable, elderly population share, refers to 2016. Using cross-country variation only greatly limits the potential to capture unobserved cross-country heterogeneity and renders omitted variable bias a potential risk. However, given the nature of our object of analysis – impact of elderly share on climate policy ambition – a panel data within estimator would not necessarily be more appropriate here given our research object: our primary concern is not so much how within-country changes in the elderly share impact climate policy ambition, but rather how cross-country differences (in the elderly share) explain differences in climate policy ambition. Only the latter is of any relevance in the current architecture of international climate policy based as it is on comparing mitigation efforts across countries to minimize free-riding in the Paris pledge-and-review system.[3]

[3] Another reason for using cross-section data is one of data availability and the nature itself of our main variables of interest: a country's age structure changes slowly while climate policy ambition not only changes slowly but has only become a salient policy option in recent years for most countries. Also, data for measures of climate policy ambition, our dependent variable, are only available for one year.

Our identification strategy is thus based on the selection on observables assumption in a cross-country context. Insofar as we are interested in identifying the link between the older population and climate policy ambition, we control for all observable variables that may confound this effect (Table 1). For instance, a country's income level might be related to both climate actions and its share of elderly population. A higher (lower) share of elderly is necessarily related to GDP per capita and this is in turn may explain climate ambition policies (because, for instance, a higher income implies more *room* to worry about environmental issues). Therefore, we control for GDP per capita so that the effect of the elderly share on climate policy is not confounded by economic development differences.

Secondly, a country that is more exposed and, therefore, more vulnerable to extreme weather events may be more willing to commit to a more stable climate, at the same time as these extreme events may affect its population structure (because of death risk or migration shocks). Here, we use data from the climate risk index (Eckstein et al., 2019) to control for fatalities and GDP losses attributable to extreme weather events. Finally, we also control for general government health expenditure (as a share of GDP) to control for relevant institutional factors: for instance, public expenditure on the health system may affect the elderly share and signal also an institutional predisposition towards State intervention in public goods, such as climate stability. Controlling for all these covariates helps our regression model to better identify the direct effect of the elderly on climate policy ambition and not to be confounded by other potential explanatory paths.

Figure 3 shows the share of elderly across different regional classifications and income groups. It is worth stressing again that without controlling for income level, any effect of the elderly population on climate policy would lack credibility when comparing, for instance, North American or European countries (15% share of elderly on average) with African countries (3–5%), as these regions also reflect global income distribution. Similarly, we cluster standard errors at the regional level to account for potential error autocorrelation at the geographical level.

Empirical strategy

To isolate the direct effect of aging on climate policy ambition, we need first to control for observable variables that might influence a country's climate policy and its share of elderly. Failure to do so would mean the effect of the elderly on climate policy would be mixed with other spurious associations through potential confounders. To measure the direct effect of aging on countries' efforts to tackle climate change, we estimate the following cross-section linear model for country i:

$$Climate\ Policy\ Ambition_i = \alpha + \beta_1 Elderly_i + \sum_j \delta_j X_i + u_i \quad (1)$$

Climate policy ambition refers to one of the three indicators described above, that is, either NDC pledge (Meinshausen et al., 2022), NDC warming metric (Robiou Du Pont & Meinshausen, 2018) or (adjusted) climate change laws (Eskander et al.,

Table 1 Descriptive statistics and data sources

Variable	Mean	S.D.	Min	Max	Data source
Dependent variables					
Unconditional NDC (%Δ CO2pc 2019–2030)	11.81	32.14	-81.12	121.05	Meinshausen et al. (2022)
Conditional NDC (%Δ CO2pc 2019–2030)	-0.10	31.20	-112.8	121.05	Meinshausen et al. (2022)
NDC warming metric (C°)	2.97	1.60	1.2	5.1	Robiou du Pont and Meinshausen (2018)
Climate change laws in 2019	8.89	6.06	1	38	Eskander et al. (2021)
Quality adj. CC laws in 2019	4.64	4.22	0.16	27.20	Eskander et al. (2021)
Lifetime quality adj. CC laws in 2019	46.29	43.60	1.11	234.21	Eskander et al. (2021)
Independent variables					
Pop. age > 65 (%)	8.40	5.85	0.99	26.59	World Bank data (2020)
Losses millions PPP US$ (1997–2016)	871.43	4,160.35	0.01	40,300.09	Eckstein et al. (2019)
Annual Avg. Fatalities (1997–2016)	145.19	647.39	0.00	7097.75	Eckstein et al. (2019)
GDP p.c. (PPP 2017 international $)	20,094.92	20,524.87	794.60	120,000.00	World Bank data (2020)
Low income country (= 1)	0.11	0.32	0	1	World Bank data (2020)
Lower-middle income country (= 1)	0.22	0.41	0	1	World Bank data (2020)
Upper-middle income country (= 1)	0.26	0.44	0	1	World Bank data (2020)
High income country (= 1)	0.41	0.49	0	1	World Bank data (2020)

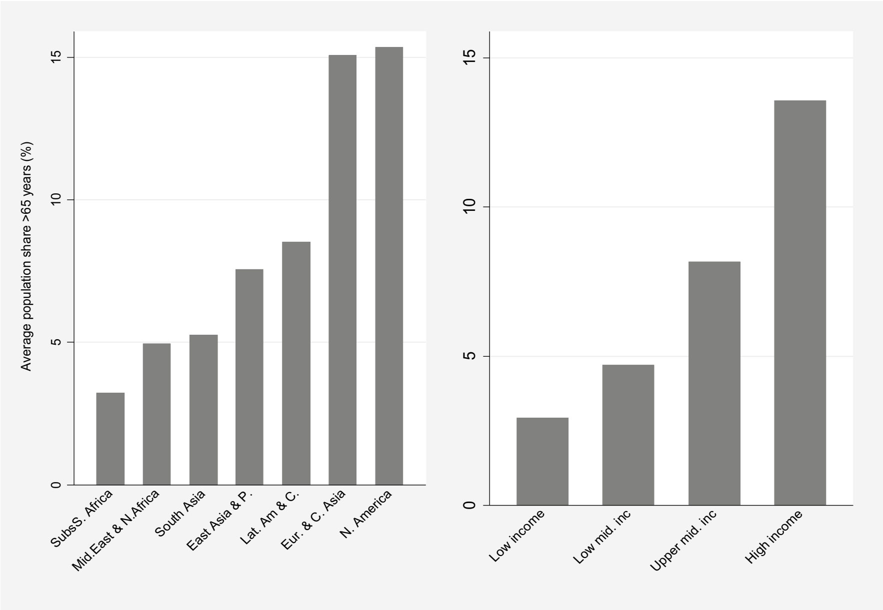

Fig. 3 Share of elderly over total population across different regions and income groups

2021). Our main variable of interest is the share of population older than 65 years.[4] Thus, X stands for the control covariates described: Income group, climate event fatalities, GDP losses attributable to climate events, and government health expenditure as share of GDP.

Despite these control covariates, unobserved factors could still be a source of confounding in our main variable of interest. For instance, cultural differences could be associated with both the share of elderly and climate policy ambition, resulting in a source of potential endogeneity that would bias β_1 in Eq. (1). To address this, we instrument the share of population older than 65 with the share of female population, cardiovascular death rate and prevalence of smoking. To be a good candidate as an instrument, these instruments must be correlated with the endogenous variable (elderly population share) while uncorrelated with the error term in Eq. (1), i.e., relevance and exclusion restriction assumptions.

The share of female population ranges between 47.2 and 54.4% and its allocation is as good as randomly assigned (after removing some outlier countries[5]). Given the higher life expectancy of women, this is positively correlated with the share of

[4] Because our variable of interest is the % of population older than 65 years, younger population is absorbed by the constant and the interpretation of the coefficient is to be read as the increase of climate policy ambition as compared to a similar change in the percentage of younger population.

[5] The outliers are Qatar (24%), UAE (30%), Oman (34%), Bahrain (37%), Maldives (39%), Kuwait (40%), Saudi Arabia (42%) and Equatorial Guinea (44%).

aged population without, arguably, affecting a country's willingness to fight climate change. Secondly, cardiovascular disease is more frequent in the elderly; hence, the higher the death rate from this cause, the higher the country's elderly share is likely to be. Finally, a larger share of adults is expected to be positively associated with a higher smoking prevalence, which in turn correlates with a larger share of elderly (besides, smoking habits have decreased substantially all over the world in recent decades). This means a higher share of tobacco use is also more concentrated among the elderly. As such, all three instrumental variables are strongly correlated with the share of elderly in a given country, yet none of them is apparently connected to a country's climate policy ambition.

It could be argued, however, that both smoking prevalence and cardiovascular death rate may be correlated with a country's climate ambition through institutional factors: that is, a country that publicly promotes healthy habits among its inhabitants may also have a higher propensity towards supporting environmental issues. To close this potential back door in our instruments, we opt to retain the government health expenditure control variable. This helps ensure that our instruments relate to climate policy only through aged population shares (additionally, we test this identification strategy by using alternative instruments as a robustness check).

By adopting this procedure, we limit the variation of our endogenous variable, aged population share, to the variation driven by our instruments. The procedure requires our instruments to hold both relevance and exclusion restriction assumptions. To test these assumptions, we use both the Hansen test of overidentification (where the null hypothesis is that instruments are uncorrelated with the error term: exclusion restriction) and the Stock and Yogo (2005) test for weak instruments.

As a summary of our identification strategy, Fig. 4 shows a diagram with the corresponding path analysis (Pearl & Mackenzie, 2018). Note that we do not control for life expectancy because this may lead to a collider bias: both GDP per capita and climate events impact life expectancy (although our results remain unchanged when it is included).

Results

Table 2 presents the estimates of the effect of the share of elderly population on the 2030-NDC pledge, unconditional and conditional on external support, the latter representing the full implementation of the NDC pledge. Neither of the two OLS estimates in columns (1) and (2) are statistically significant: in the case of the conditional NDC, the sign of the coefficient is positive, while in that of the unconditional NDC, the sign is negative (indicating a lower reduction in 2030 per capita emissions in line with the NDC pledge).

However, since the countries that present a high profile in terms of their climate policy ambition may also be more advantaged in other aspects – aspects that are potentially omitted from this specification – the OLS estimates in columns 1 and 2 may be capturing these omitted effects rather than the actual effect of the share of the elderly. This being the case, the Ramsey test cannot reject the null hypothesis of no omitted variables and, more importantly, we are unable to reject the null hypothesis of

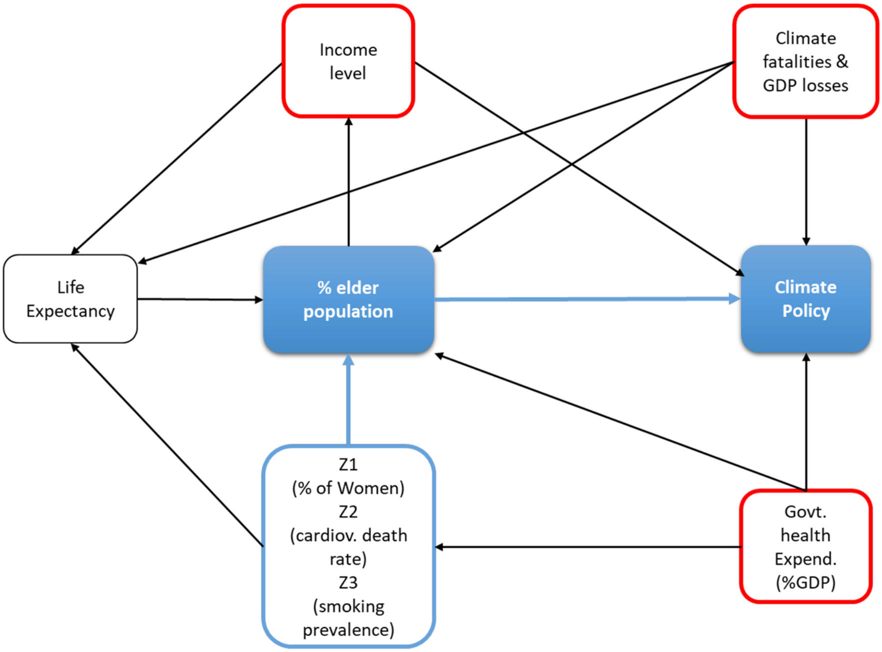

Fig. 4 Causal path diagram. Notes: The causal path diagram illustrates the hypothesized relationship between relevant variables. Arrows indicate the direction of this relationship. Blue variables indicate the main causal path we are interested in isolating. Red variables are the variables we control for in our specification. Z variables are the instruments used in the IV estimation

the Durbin-Wu-Hausman (DHW) test, meaning that the share of the elderly population is endogenous to climate policy.[6] Therefore, IV models are more appropriate here. The IV estimates in columns (3) and (4) yield negative coefficients and statistically significant in the latter despite their larger standard errors. Table 6 shows coefficients for control variables included. Table 7 shows the first stage estimates demonstrating instrument relevance and the F-statistic of that first stage[7] is higher than the Stock and Yogo (2005) critical values, hence the instruments cannot be considered weak.[8] Secondly, the instruments are uncorrelated with a country's climate policy (exclusion restriction), as shown by the Hansen test: that is, we cannot reject the null hypothesis that the instruments are valid. All in all, this means that our IV estimation is effective in ruling out any potential endogeneity in the OLS estimates. Thus, a higher share

[6] See Table 12 in the appendix for the results of the DWH test. The variable is found to be endogenous for all specifications except that of the unconditional NDC pledge, for which point estimates between IV and OLS are relatively close (see Fig. 5).

[7] Since we cluster standard errors (at the regional level), Stock-Yogo critical values are compared with the Kleibergen-Paap Wald rk F statistic, as opposed to the Cragg-Donald Wald F statistic (which here recorded a value of 19.05).

[8] According to Stock and Yogo (2005) a group of instruments are considered weak if the bias of the IV estimator exceeds 10% of the bias of the OLS estimator.

Table 2 Impact of elderly share on climate policy ambition as measured by 2030-NDC pledges

VARIABLES	(1) OLS (Uncond. NDC)	(2) OLS (Cond. NDC)	(3) IV (Uncond. NDC)	(4) IV (Condtional NDC)
Pop. age > 65 (%)	0.098	-0.448	-0.140	-1.913*
	(0.840)	(0.877)	(1.406)	(1.036)
Observations	124	124	124	124
R-squared	0.321	0.136	0.320	0.116
Sample	ALL	ALL	ALL	ALL
Control vars	NO	NO	YES	YES
Adj R-squared	0.280	0.0840	0.279	0.0627
Variance Inflation Factor	3.26	3.26		
Ramsey Test (F Stat)	0.21	0.27		
Ramsey p value	0.887	0.843		
First stage F stat			8.750	8.750
(Stock-Yogo critical v.-10%)			(6.46)	(6.46)
Hansen			3.658	3.061
Hansen p value			0.161	0.216

Robust standard errors in parentheses

*$p<0.1$; **$p<0.05$; ***$p<0.01$

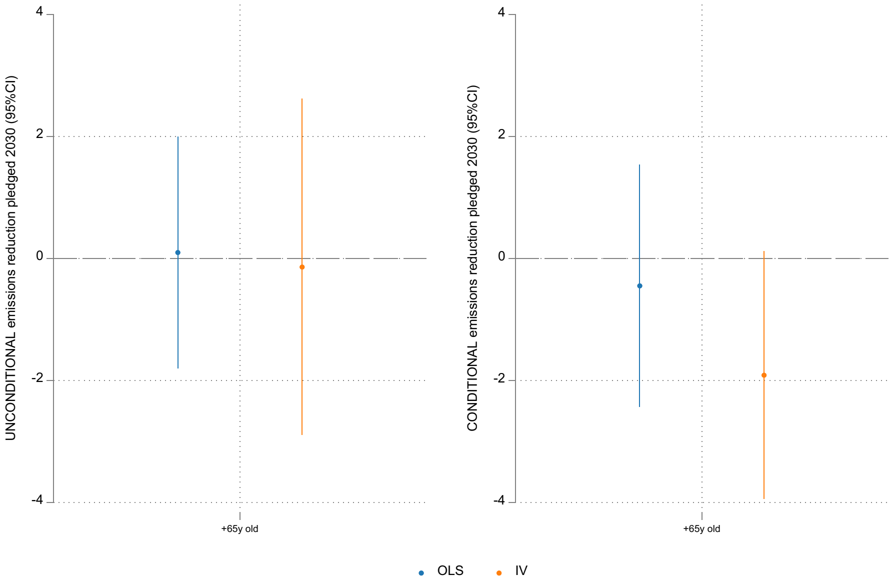

Fig. 5 Impact of elderly share on 2030-NDC per capita emissions according to OLS and IV estimates

Table 3 Impact of elderly share on climate policy ambition as measured by NDC warming metric

VARIABLES	(1) OLS *NDC-C°*	(2) IV *NDC-C°*
Pop. age > 65 (%)	0.025*	0.094***
	(0.012)	(0.020)
Observations	121	121
Cluster s.e	Region	Region
R-squared	0.613	0.492
Sample	ALL	ALL
Control vars	NO	YES
Adj R-squared	0.589	0.461
Variance Inflation Factor	3.23	
Ramsey Test (F Stat)	3.02	
Ramsey p value	0.0329	
First stage F stat		8.741
(Stock-Yogo critical v.-10%)		6.46
Hansen		2.864
Hansen p value		0.239

Robust standard errors in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

of aged population (and hence a lower share of younger population) reduces climate ambition on average, especially when we consider conditional pledges: a percentage point increase in the elderly share reduces NDC ambition with pledged emissions per capita being 1.9% higher in 2030 (Fig. 5).

Table 3 shows the results for the NDC warming metric. Column (1) again shows the results for the OLS estimate and column (2) for the IV estimate. The story above is repeated here: the OLS estimate is biased because of endogeneity and the IV estimate increases the size effect of the influence of the elderly population on climate policy ambition.[9] A higher NDC warming is associated with lower ambition; hence, our results are consistent. Specifically, an additional 1% share of older population is associated, on average, with an NDC pledge consistent with 2.5% greater global warming according to OLS. Once we correct for potential endogeneity, the IV estimates show that a 1% increase in the share of elderly is associated with an NDC pledge consistent with 9% greater global warming, or +0.28 °C, similar to the average global temperature increase per decade.

Finally, we replicate the same analysis in Table 4 using the same instrumental variables but with the number of climate change laws as our measure of climate

[9] Tables 8 and 9 show, respectively, the coefficients of the control variables and the first stage results for the IV estimates.

Table 4 Impact of elderly share on climate policy ambition as measured by climate change laws

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	IV	IV	IV
VARIABLES	*CC laws*	*Quality Adj. CC laws*	*Quality and lifetime Adj. CC laws*	*CC laws*	*Quality Adj. CC laws*	*Quality and lifetime Adj. CC laws*
Pop. age > 65 (%)	-0.270	-0.205*	-1.699	-0.697**	-0.585***	-5.374***
	(0.213)	(0.104)	(1.006)	(0.279)	(0.150)	(1.678)
Observations	122	122	122	122	122	122
R-squared	0.243	0.522	0.543	0.205	0.466	0.494
Sample	ALL	ALL	ALL	ALL	ALL	ALL
Control vars	NO	NO	NO	YES	YES	YES
Adj R-squared	0.196	0.492	0.514	0.156	0.433	0.463
Variance Inflation Factor	3.28	3.28	3.28			
Ramsey Test (F Stat)	2.55	5.79	7.28			
Ramsey p value	0.059	0.001	0.00			
First stage F stat				8.401	8.401	8.401
(Stock-Yogo critical v.-10%)				(6.46)	(6.46)	(6.46)
Hansen				3.851	4.161	3.171
Hansen p value				0.146	0.125	0.205

Robust standard errors in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

policy ambition (Table 10 replicates this same table with the coefficients of control variables). We show separate estimates for the raw number of climate laws, quality-adjusted climate laws and lifetime quality-adjusted climate laws. Again, the instrumental variables appeared appropriate and exogenous: OLS estimations (columns 1 to 3) do not pass the Ramsey test suggesting omitted variable bias, while the DWH test indicates potential endogeneity (Table 12); hence, we focus on the IV models only (columns 4 to 6). These confirm a negative association between the elderly population and cross-country climate policy action.

In this case, a 1% increase in the share of the elderly population is associated with almost one law fewer against climate change (-0.7) – or, alternatively, a 10% difference in the elderly share is associated, on average, with seven fewer climate laws. When this measure is adjusted by the quality of the country's rule of law, we find, on average, six fewer climate laws (column 5) or 54 fewer law-years (column 6). Figure 6 shows the different coefficients for all specifications and estimators. In all cases, the use of the IV estimator increases the standard errors (as is expected from the efficiency loss of IV estimators) as well as the statistical significance, driven by the increase in the size effect.

Taken together these results confirm that countries with a higher share of aged population are less ambitious in their climate policy than they would be otherwise. This negative effect, however, is only identified once we remove endogeneity biases from the unobserved factors. Our IV estimates are relevant

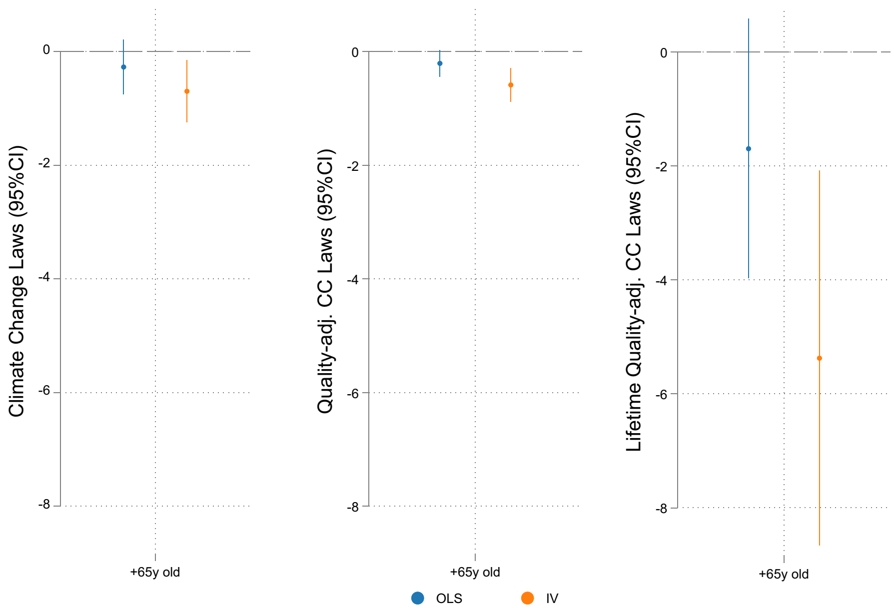

Fig. 6 Impact of elderly population share on the number of climate change laws

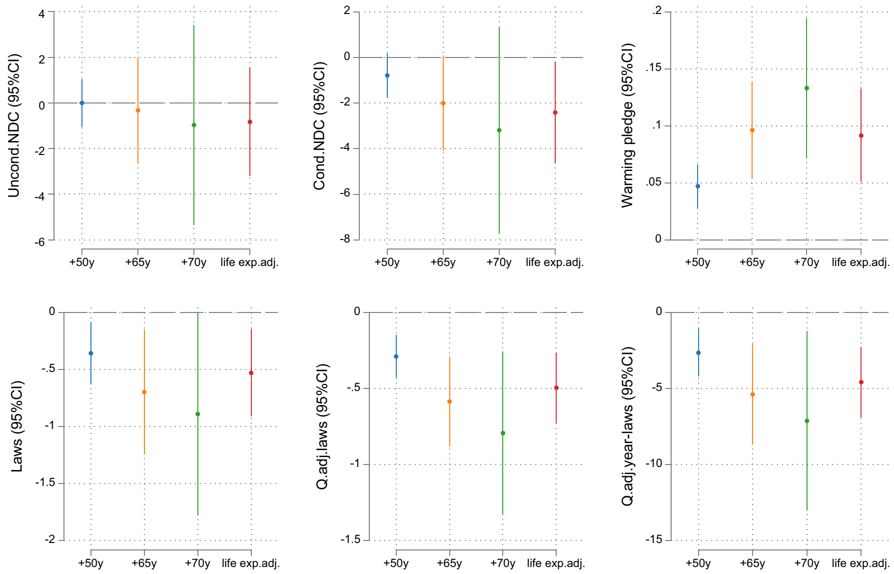

Fig. 7 Impact of elderly population according to different cutoffs in the definition of elderly

and satisfy both the exclusion restriction and validity assumptions regardless of how climate policy ambition is measured.

Robustness checks

Life expectancy

Our results show that climate ambition falls as the countries' share of elderly population increases. However, life expectancy is not evenly distributed across countries, so while living beyond the age of 65 is expected in more than 75% of countries, in the remaining quarter life expectancy is below this age and so, automatically, these latter countries will have a lower share of people aged over 65. To see if our results are driven by differences in life expectancy, we replicated IV estimates controlling for this variable. The results remained unchanged in both size and significance for most of the models (Table 11 in the appendix). However, as noted earlier, including life expectancy in the specification may be problematic due to collider bias.[10]

[10] In fact, this is consistent with the Hansen test rejecting instrument validity for three of the six models in Tables 11, indicating that the correlation of instruments with the error term increases when this covariate is included.

Table 5 Impact of elderly share on climate policy ambition with alternative instrumental variables

VARIABLES	(1) Uncond. NDC	(2) Conditional NDC	(3) *NDC-C°*	(4) *CC laws*	(5) *Quality Adj. CC laws*	(6) *Quality and lifetime Adj. CC laws*
Intruments: Women pop. share						
Life-exp. Adj. Elderly sh	-1.866	-3.370**	0.058***	-0.098	-0.239	-2.350
	(1.209)	(1.477)	(0.020)	(0.245)	(0.149)	(1.768)
Observations	161	161	153	158	158	158
First stage F stat	25.45	25.45	27.97	24.94	24.94	24.94
Hansen	-	-	-	-	-	-
Hansen p value	-	-	-	-	-	-
Intruments: Women pop. share and COVID-19 deaths per million inhab						
Life-exp. Adj. Elderly sh	-1.800	-2.919**	0.054**	-0.142	-0.309**	-3.064*
	(1.158)	(1.423)	(0.023)	(0.251)	(0.146)	(1.778)
Observations	150	150	143	148	148	148
First stage F stat	11.13	11.13	11.28	10.63	10.63	10.63
Hansen	0.182	0.00	1.420	1.116	0.266	0.148
Hansen p value	0.670	0.998	0.233	0.291	0.606	0.701

Robust standard errors in parentheses

*$p<0.1$; **$p<0.05$; ***$p<0.01$

Alternative definitions of the elderly population

Our definition of the elderly as the population older than 65 might be considered arbitrary. Here, we replicate the analysis redefining our target population. Figure 7 provides IV estimates of the instrumented elderly share, when considering the share of population older than 50. We compare this with the previous definition of elderly (older than 65) and include, for the sake of comparison, estimates for the population older than 70. Finally, we also include an ad hoc definition of old population in relation to a county's life expectancy in order to account for the heterogeneity in life expectancies across countries: thus, if life expectancy is lower than 70, we consider the elderly as being those older than 50. For life expectancies between 70 and 80, we retain the elderly as the share of population older than 65. Finally, for those countries whose life expectancy is above 80, the elderly are considered as those being over the age of 70.[11] Results are robust to all these different definitions of the elderly population and consistent with the idea that the demographic transition is a barrier to a stronger commitment in the climate policy arena.

Alternative instruments

Finally, Table 5 shows the estimates when using alternative instruments. In our main estimates, we used more instruments than endogenous variables in order to have an overidentifying restriction. As the test results show, the instruments were found to be valid in terms of relevance, exclusion restriction and monotonicity. However, it could be argued that only the share of women in a country can be considered as being truly random and, hence, an independent instrument: as discussed, the share of women in a country can never be far from 50% and, so, any variation in this cut-off can be considered as good as random. Moreover, a higher share of women implies a higher share of elderly, given that women, on average, live longer than men. All this being independent of climate policy. Results remain consistent with the main estimates when we use a just-identified model (i.e. using only the share of women in a country as the sole instrumental variable). Secondly, we also combine the IV estimates of the women share with COVID-19 deaths per million (OWID, 2021). As is known, the COVID-19 virus was potentially more fatal for the elderly, especially during the first year of the pandemic when there were no vaccines. Both instruments are found to be valid and relevant, and can be considered more independent than the previous instruments; however, results remain unchanged.

[11] These cut-offs at ages 50, 65, and 70 reflect data availability (UN, 2019).

Conclusion and policy implications

The increasing urgency of climate change and its wider ramifications require greater efforts on the part of all to understand the factors that hinder stronger, more forceful actions by governments to tackle the ever-pressing challenges. Here, we report empirical evidence of another of the great challenges faced by contemporary societies, namely, population aging, and explore its impact in the public debate on climate change policy. To date, most of the links established in the literature between climate change and demographic transition have concerned the potentially higher risk to the elderly of the effects of climate change given their greater vulnerability. However, the results reported here point to a different relationship between aging and climate change action – albeit one consistent with the potential vulnerability of the elderly – whereby the greater demographic weight of older age groups, in line with our hypothesis, acts as a brake on stronger, more ambitious government action.

Our findings are closely aligned with evidence from studies based on individuals' age-based differential preferences and behaviors and with the literature that predicts a greater political influence of the elderly. Our findings lend further support for theories and evidence positing the relative importance of the time discount factor (see, for example, Oster et al., 2013; Huffman et al., 2019) and, therefore, theories based on the maximization of one's own well-being under heterogeneous time frames.

A common limitation of studies in this field (and one that also applies to this paper) is the inability to determine whether elderly effects are driven solely by age or by a cohort effect. However, studies of the factors that explain a higher frequency of support for conservative electoral platforms among the older population have found a significant effect of age, even after controlling for cohort effects (Tilley & Evans, 2014). Sørensen (2013) and De Mello et al. (2017) have reported similar findings for age-related preferences for public spending and prioritization of public policies. Lichtin et al. (2023) analyze forty elections in eleven western countries and find that each generation is more supportive of green parties than the previous generation. However, they also a find a negative age effect. Here, moreover, it is worth noting that our study is concerned with policy action against climate change, which clearly falls within a context of universal values and effects, rather than within what are strictly national domains. In this regard, our results are consistent with Goerres's (2007: 96) proposal that individual aging exerts a stronger influence on age effects that stem from universal values, while generational effects are more influential in age effects that depend on national context.

Although we studied the effects of aging on government action in an aggregate fashion, our results lend little support to the legacy theory. Yet, this theory does provide a feasible path to mitigating the problem posed in the present study. Having identified the role of aging, founded on preferences and perceptions typical of the older age group, an awareness of intergenerational and continuity effects on the legacy bequeathed and inherited should constitute a fundamental element of climate change policy, targeting very specific populations such as those adults who will soon become elderly and the current older population. A committed policy action centered on information and awareness campaigns for clearly defined target populations seems desirable to us, regardless of whether the effect found in our study is an age-related effect or a cohort effect. In any case, future research can further disentangle this.

In sum, this article paves the way for further research on the connections between two of the greatest challenges facing contemporary societies, a question that will require academia and governments alike to look again at the specific effect an aging population might be having today on climate change, but above all, at the impact it might have in the not too distant future.

Appendix

Tables 6 and 10

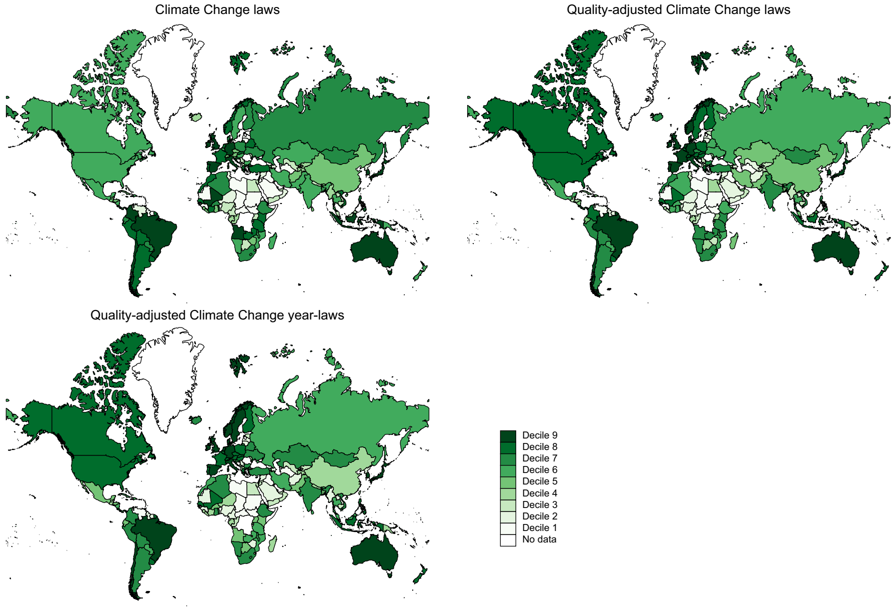

Fig. 8 Distribution of legislative and executive climate change laws according to Eskander et al., (2021)

Table 6 Impact of elderly share on climate policy ambition as measured by 2030-NDC pledges (this is Table 2)

	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
VARIABLES	Cond. NDC	Cond. NDC	Uncond. NDC	Uncond. NDC
Pop. age > 65 (%)	0.098	-0.448	-0.140	-1.913*
	(0.840)	(0.877)	(1.406)	(1.036)
ln(Losses US$ from extreme climate events)	-0.927	-2.253*	-0.888	-2.015**
	(1.376)	(1.065)	(1.301)	(0.881)
ln(Fatalities from extreme events)	1.689	1.569	1.730	1.821
	(1.956)	(1.596)	(1.768)	(1.482)
Govt. Health Expend (GDP%)	3.102**	3.690*	3.302**	4.923***
	(0.996)	(1.656)	(1.401)	(1.573)
Low-middle income	10.822	12.367	11.171	14.511
	(9.021)	(10.871)	(8.472)	(9.923)
Upper-middle income	14.767*	9.152	15.873*	15.955**
	(7.154)	(6.769)	(8.574)	(7.827)
High income	33.502**	22.080	35.946*	37.115**
	(14.787)	(12.123)	(18.759)	(15.802)
Constant	-21.412***	4.779	-21.096***	6.722
	(6.276)	(6.296)	(5.669)	(6.067)
Observations	124	124	124	124
R-squared	0.321	0.136	0.320	0.116
Sample	ALL	ALL	ALL	ALL
Control vars	NO	NO	YES	YES
Adj R-squared	0.280	0.0840	0.279	0.0627
Variance Inflation Factor	3.26	3.26		
Ramsey Test (F Stat)	0.21	0.27		
Ramsey p value	0.887	0.843		
First stage F stat			8.750	8.750
(Stock-Yogo critical v.-10%)			(6.46)	(6.46)
Hansen			3.658	3.061
Hansen p value			0.161	0.216

Robust standard errors in parentheses

$^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 7 First stage of IV estimator in Table 2 (endogenous variable: elderly share)

VARIABLES	(1)
Smoking adults (%)	0.073*
	(0.036)
Cardiovasc death rate	0.007***
	(0.002)
Female Pop. (%)	0.912***
	(0.259)
ln(Losses US$ from extreme climate events)	0.275*
	(0.133)
ln(Fatalities from extreme events)	-0.035
	(0.198)
Govt. Health Expend (GDP%)	0.795**
	(0.290)
Low-middle income	0.625
	(0.343)
Upper-middle income	3.612***
	(0.594)
High income	9.821***
	(1.778)
Constant	-48.412***
	(13.934)
Observations	124
R-squared	0.853
Adj R-squared	0.842

Robust standard errors in parentheses

*$p<0.1$; **$p<0.05$; ***$p<0.01$

Table 8 Impact of elderly share on climate policy ambition as measured by NDC warming metric (this is Table 3)

VARIABLES	(1) lnDupont	(2) lnDupont
Pop. age > 65 (%)	0.025*	0.094***
	(0.012)	(0.020)
ln(Losses US$ from extreme climate events)	0.031*	0.019
	(0.014)	(0.014)
ln(Fatalities from extreme events)	-0.073	-0.085**
	(0.043)	(0.035)
Govt. Health Expend (GDP%)	-0.001	-0.060
	(0.034)	(0.039)
Low-middle income	0.288	0.184
	(0.175)	(0.167)
Upper-middle income	0.934***	0.624***
	(0.121)	(0.104)
High income	0.694***	-0.017
	(0.146)	(0.251)
Constant	-0.145	-0.234**
	(0.124)	(0.092)
Observations	121	121
R-squared	0.613	0.492
Sample	ALL	ALL
Control vars	NO	YES
Adj R-squared	0.589	0.461
Variance Inflation Factor	3.23	
Ramsey Test (F Stat)	3.02	
Ramsey p value	0.0329	
First stage F stat		8.741
(Stock-Yogo critical v.-10%)		6.46
Hansen		2.864
Hansen p value		0.239

Robust standard errors in parentheses
$*p<0.1$; $**p<0.05$; $***p<0.01$

Table 9 First stage of IV estimator in Table 3

VARIABLES	(1) 1st Stage
Smoking adults (%)	0.068*
	(0.035)
Cardiovasc death rate	0.006***
	(0.001)
Female Pop. (%)	1.05***
	(0.268)
ln(Losses US$ from extreme climate events)	0.309**
	(0.144)
ln(Fatalities from extreme events)	-0.000
	(0.19)
Govt. Health Expend (GDP%)	0.779***
ln(Losses US$ from extreme climate events)	(0.284)
Observations	121

Table 10 Impact of elderly share on climate policy ambition as measured by normalized number of climate change laws (this is Table 4)

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	IV	IV	IV
VARIABLES	*CC laws*	*Quality Adj. CC laws*	*Quality and lifetime Adj. CC laws*	*CC laws*	*Quality Adj. CC laws*	*Quality and lifetime Adj. CC laws*
Pop. age > 65 (%)	-0.270	-0.205*	-1.699	-0.697**	-0.585***	-5.374***
	(0.213)	(0.104)	(1.006)	(0.279)	(0.150)	(1.678)
ln(Losses US$ from extreme climate events)	0.904***	0.533***	6.254***	0.967***	0.589***	6.801***
	(0.201)	(0.130)	(1.316)	(0.190)	(0.102)	(0.941)
ln(Fatalities from extreme events)	0.195	0.088	-0.927	0.265	0.151	-0.320
	(0.561)	(0.352)	(2.317)	(0.584)	(0.395)	(2.918)
Govt. Health Expend (GDP%)	0.961**	0.853***	7.692***	1.314***	1.167***	10.739***
	(0.401)	(0.178)	(1.757)	(0.332)	(0.093)	(1.407)
Low-middle income	-1.566**	-0.661*	-6.906*	-0.942*	-0.105	-1.525
	(0.534)	(0.326)	(3.750)	(0.523)	(0.393)	(3.772)
Upper-middle income	-1.748	-0.556	-8.350	0.160	1.142	8.096
	(2.051)	(0.785)	(7.548)	(2.027)	(1.025)	(9.219)
High income	1.407	4.480***	46.588**	5.823	8.410***	84.642***
	(1.609)	(0.712)	(15.864)	(3.804)	(2.768)	(30.799)
Constant	6.314***	1.214	4.583	6.900***	1.736	9.638
	(1.756)	(0.998)	(7.047)	(2.071)	(1.378)	(10.427)
Observations	122	122	122	122	122	122
Cluster s.e	region	region	region	region	region	region
R-squared	0.243	0.522	0.543	0.205	0.466	0.494
Sample	ALL	ALL	ALL	ALL	ALL	ALL

Table 10 (continued)

VARIABLES	(1) OLS *CC laws*	(2) OLS *Quality Adj. CC laws*	(3) OLS *Quality and lifetime Adj. CC laws*	(4) IV *CC laws*	(5) IV *Quality Adj. CC laws*	(6) IV *Quality and lifetime Adj. CC laws*
Control vars	NO	NO	NO	YES	YES	YES
Adj R-squared	0.196	0.492	0.514	0.156	0.433	0.463
Variance Inflation Factor	3.28	3.28	3.28			
Ramsey Test (F Stat)	2.55	5.79	7.28			
Ramsey p value	0.059	0.001	0.00			
First stage F stat				8.401	8.401	8.401
(Stock-Yogo critical v.-10%)				(6.46)	(6.46)	(6.46)
Hansen				3.851	4.161	3.171
Hansen p value				0.146	0.125	0.205

Robust standard errors in parentheses

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 11 Impact of elderly share on climate policy ambition (IV estimates) as measured by different indices and controlling for country life expectancy

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	*Unconditional NDC*	*Conditional NDC*	*NDC-C°*	*CC laws*	*Quality Adj. CC laws*	*Quality and lifetime Adj. CC laws*
popsh65	-0.745	-2.353	0.095***	-0.670**	-0.585***	-5.366***
	(1.617)	(1.611)	-0.022	-0.323	-0.187	-2.07
Observations	124	124	121	122	122	122
R-squared	0.320	0.118	0.491	0.239	0.497	0.526
Sample	ALL	ALL	ALL	ALL	ALL	ALL
Control vars	YES	YES	YES	YES	YES	YES
Adj R-squared	0.273	0.0568	0.455	0.185	0.461	0.492
First stage F stat	16.61	16.61	19.32	15.37	15.37	15.37
Hansen	7.470	5.494	1.767	5.701	4.206	2.568
Hansen p value	0.0239	0.0641	0.413	0.0578	0.122	0.277

Robust standard errors in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table 12 Durbin-Wu-Hausman test

	Conditional NDC21	Unconditional NDC	NDC-C°	CC laws	Q.adj. CC laws	Q.adj. CC year laws
F test	1.99	7.71	13.79	2.45	14.97	8.7
p value	0.191	0.021	0.004	0.15	0.003	0.016

Author's contribution All authors contributed equally to this work.

Funding Open Access funding provided thanks to the CRUE-CSIC agreement with Springer Nature. This work was supported by the *Ministerio de ciencia e innovación/Agencia Estatal de Investigación* under Grant number PID2019-104319RB-I00.

Data availability All data sources are publicly available and directly downloadable from the sources indicated in the Data section.

Declarations

Competing interests 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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