Are Political Leaders with Professional Background in Business Bad for Climate Mitigation?

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Luis Diaz-Serrano [a,b,(*)] and Giorgos Kallis [c,d]

Abstract

Do political leaders affect the climate mitigation of the nation they govern, and if yes, to which leader characteristics voters who care about climate should pay attention to when they vote? There is abundant literature on how ideology of political parties in power affects climate policy outcomes, but there is nothing similar for individual characteristics of government leaders. This is the first study of its kind, building on a dataset of government leaders of OECD countries for the period 1992-2017, we find that leaders' professional background is the trait that has the strongest effect. Higher emissions and lower renewable energy deployment are more likely during the tenure of former businesspersons or economists. Teachers and doctors instead are associated with lower emissions and with higher rates of renewable energy deployment. Our results suggest that voters and pressure groups should care about candidates' professional background, in addition to their party's ideology.

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Conflicts of interest/Competing interests

There is no conflict of interest involved in this research.

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Data available from the authors upon request.

Code availability (software application or custom code)

Code available from the authors upon request.

Authors' contributions

LDS conceived the project, designed the research and tests, and ran the econometric analysis. GK led the writing of the article. Both authors collaborated in the collection of the data and the analysis and interpretation of results.

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Introduction

There is abundant literature linking the ideology of the political parties of the elected leaders in office and carbon emissions and climate policy (King and Borchardt, 1994; Jahn, 1998; Scruggs, 1999; McCright and Dunlap RE, 2003; Neumayer, 2003; Garmann, 2014; Dietz et al., 2015). However, studies linking individual characteristics of elected leaders and climate policy outcomes are inexistent. This is a gap in the literature that claims for attention. On the one hand, there is a growing literature finding important effects of leaders' individual characteristics on a wide variety of economic policy outcomes (Jones and Olken, 2005; Congleton and Zhang, 2009; Dreher et al., 2009; Besley et al., 2011; Hayo and Neumeier, 2014). On the other hand, some studies report a personalization process of modern politics (Caprara and Zimbardo, 2004; Caprara, 2007; Garzia, 2011), what implies that individual characteristics of candidates is becoming more important for voters (Winter, 1987; Bittner, 2011; Vecchione et al., 2011; King, 2002; Cutler, 2003; Aarts et al., 2013; Campbell and Cowley, 2013; Costa and Ferreira da Silva, 2015; Ferreira da Silva and Costa, 2018; Sevi, 2020).

The election of Donald Trump in 2016 raised concerns about the prospects for climate mitigation in the U.S., the world's second highest emitting economy, responsible for almost 15% of global emissions (and in relation his defeat and election of Joe Biden, raises hopes of renewed climate actions). Some analysts argue, however, that there is little that even a strident opponent of climate action like ex-President Trump could do to reverse trends towards decarbonization, since emissions are driven by technological and macroeconomic developments, and not climate policies (Nordhaus et al., 2017). On the other hand, we know that peoples' attitudes towards climate change and mitigation are shaped by their political affiliation and the approval (or not) of leaders with positive or negative stances towards climate mitigation (Shao and Hao, 2019).

This circumstance raises the question of whether political leaders matter for climate policy and climate policy outcomes, and if yes, how? What interests us here in particular is

whether there are characteristics of individual politicians that make a difference when it comes down to climate mitigation, over and above say the effect of their party's politics or their ideology. In other words: are there leader features that predict which politicians will be good for the climate and which ones bad? This study finds that leaders' prior profession does make a difference when it comes to climate outcomes and that leaders with backgrounds in business and economics do notably worse on climate mitigation.

The interest about the reasons and consequences of businesspersons in politics stems from the fact that during this century the amount of businesspersons running for and being elected in office at different levels of public administration (from local to national level) has increased dramatically around the world. More specifically, according to our data, between 1992 and 2017, 19 businesspersons have been elected to be in the presidential office of the OECD countries, with most of them being elected after mid-2000s. Gehlbach et al. 2010, show that businesspersons are more likely to run for office in countries with weak electoral institutions, therefore, we can expect the share of businesspersons running for office to be much higher in developing and middle-income countries. The literature analysing the reasons and consequences of businesspersons in politics is taking-off, but still there is a gap since most of the studies focus on how and why businesspersons take office, but little is known yet about the consequences. At this regard, Szakonyi (2020) is an exception. Our results contribute to fill this gap and bring some light to the debate about the consequences of businesspersons running for and serving in political office (Diermeier et al., 2005; Gehlbach et al., 2010; Braendle, 2016; Szakonyi, 2020), by analysing the impact of businesspersons on climate change mitigation policies.

Past research on the determinants of carbon emissions has focussed on assessing and comparing the economic, technological, and policy factors that may affect emissions (Sharma, 2011; Menyah and Wolde-Rufael, 2010; Casey and Galor, 2017) - in comparison, we know next to nothing about the possible effects of political leaders and the ways their background,

120 training and characteristics influence climate mitigation (or not). Despite the richness of the
121 environmental literature, the impact of a leader's background on environmental policy and
122 outcomes has not received attention yet. There are studies that show left-wing parties in
123 government are associated with lower carbon emissions (Dietz et al., 2015; Garmann, 2014),
124 and that political parties with more pro-environmental positions are likely to adopt more
125 environmental policies when in government (Knill et al, 2010). There are no equivalent studies
126 though on the effects of leaders of government, and any impact they might have on top of
127 those that relate to their political party's agenda or their and their parties' ideology.

128 In this piece of research, we empirically test whether leaders' profession, while
129 controlling for other leaders' characteristics, may have an effect on climate mitigation policy
130 and outcomes. And more specifically, the question is whether businesspersons have an impact
131 on climate policy and outcomes, and how. We create a dataset of political leaders' ruling the
132 countries that signed the Kyoto protocol, and examine within-country variations across these
133 leaders' profession and characteristics: gender, family situation, age and years in politics. We
134 do this for a number of countries over the years, while accounting and controlling for
135 contextual differences between leaders, such as years in office, party ideology and whether
136 they govern in coalition or in minority (a proxy for their effective power).

137 Previous datasets in the literature cover long periods of time, but they start before
138 climate policies were introduced, and finish too early for our purposes (early 2000s). We
139 constructed accordingly a new dataset of political leaders and their characteristics for the
140 period 1992-2017 (1992 being the year the United Nations Framework Convention on Climate
141 Change was held) using publicly available data that we retrieved through a web-based search
142 of encyclopaedias. In line with others before us who studied the effects of political factors on
143 environmental performance, we focus on OECD countries to compare similar regimes, with
144 comparable socio-economic, political and environmental policy conditions but sufficient
145 variation in leader characteristics.

We test associations between the above variations and climate policy and outcomes, measured by the proxies of renewable energy deployment (in terms of installed capacity) and carbon emissions. One is an indicator of effort, and the other of outcomes. We do not expect that the two will move necessarily in the same direction. Until recently, the deployment of renewable energy had not demonstrably displaced fossil fuels (York, 2012); and other policies, such as regulation or taxation might have a stronger effect on emissions than the development or not of renewable energy.

Businesspersons in office and Policy Outcomes

In recent years, there is a growing literature that shows how traits of governing politicians link to policy outcomes, establishing that political leaders' identities have a discernible impact on government performance. This line of research is based on the proposition that factors related to individuals' status (such as occupation, income, or education) and life experiences (related to gender, age, training/profession) may explain differences in policy preferences and behaviour; and that the quality of leaders is key to their government's performance. One central hypothesis here is that governing leaders, at least to some degree, may pursue their own interests. Under this hypothesis, it would not be surprising that, beyond the ideology of their political parties, political leaders' characteristics might matter when it comes to the adoption of a wide variety of policies, among then, the ones intended at mitigating climate change. In the literature, there is a wide variety of studies analysing the impact of the characteristics of political leader on several policy outcomes. Empirical studies have established for example that the quality of leaders matters for economic growth (Jones and Olken, 2005), and more specifically, that more educated leaders increase rates of economic growth (Congleton and Zhang, 2009; Besley et al., 2011).[1] Constant and Tien (2010) show that foreign education of leaders matters for Foreign Direct Investments (FDI) inflows in their

[1] Contrasting findings about the effects of leaders' education are also found Carnes and Lupu (2016).

171 home countries. It is also found that leaders from lower social class backgrounds increase
172 spending and debt (Hayo and Neumeier, 2014); and that younger politicians behave more
173 strategically during elections (Alesina et al., 2019).

174 In this setting, one relevant question for voters who do care about climate change is to
175 identify which of the leaders' characteristics are more relevant as far as climate change
176 mitigation policies is concerned. We hypothesize that among all the mix of leaders'
177 characteristics, profession points as probably one of the most important leaders' qualities
178 potentially affecting policy outcomes regarding the mitigation of climate change. There is a
179 debate about private sector businesspersons serving in political office (Gehlbach et al., 2010),
180 especially at the presidential level. It would not be surprising that political leaders who were
181 in business before being elected, may promote policies with the intention to create a favourable
182 environment for businesses like theirs (if not their own business). Clear recent examples of this
183 type of behaviour are Silvio Berlusconi in Italy or Donald Trump in the US. For example,
184 Dreher et al., (2009) observed that, a presidential level, ex-businesspersons are more likely to
185 pursue liberalizing reforms that facilitate business activity. However, Beach and Jones (2016),[2]
186 at a local level, provides contrasting findings. These authors find no evidence that elected
187 candidates with a business experience had an impact on a wide variety of outcomes (e.g. city
188 expenditures and revenues). However, the fact that businesspersons do not have an impact
189 on city outcomes, or the level of administration where they hold office, does not mean that
190 their businesses cannot benefit from them holding office. For example, Szakonyi (2020) show
191 that in Russia, firms connected to wining candidates increase their revenue by 60% and profit
192 margin by 15% by the final year these candidates spend in office.

193 A central feature of climate policy is that a leader needs to take a longer-term view
194 towards future generations, a predisposition that one would assume is less likely to be found
195 among leaders with professional backgrounds and social positions that privilege immediate

[2] These authors use data of California city councils.

returns. One plausible expectation is that leaders with professional background in sectors that are trained to prioritize short-term returns, say businesses, will be less likely to act on the climate. In addition, experimental evidence, shows that economists, who share common backgrounds with businesspersons, compared to students enrolled in other university fields, are more prone to free ride (Marwell and Ames, 1981). Thus, it would be not surprising that a political leader who is a businessperson or economist, might be less interested in investing in a "public good" as the climate mitigation, than political leaders with other different backgrounds.[3] Of course, with this reasoning, we do not pretend to rule that businesspersons possess intrinsic personality traits that makes them to be innately less sensitive to the climatic change. Rather, it might also be that they simply are more prone to serve to determinate businesses environments and networks, who may constitute powerful lobbies.

Data

A paid research assistant constructed the leaders' database under our guidance. The approach was to start with an internet search of open access encyclopaedias (Wikipedia, Britannica) and find the leaders in government for each country in our dataset from 1992 to 2017. A "leader" was defined as the President in Presidential and Semi-presidential systems; and the Prime Minister in Parliamentary democracies. Once the name of the leader was found, data was compiled from the encyclopaedias on start and end date of term(s), profession, education, number of children, age, years in politics, political party and its ideology – where information was missing, this was pursued through additional web searches. We did not include interim governments lasting less than six months (at least 183 days). Each year had a separate entry.

[3] These authors ran an experiment intended at maximising the likelihood of free riding. Participants were asked to invest a number of tokens in a collective fund. The share of tokens invested that maximizes the collective benefit was 100%. On average, participants with very heterogeneous backgrounds contributed around 40-50%. Telling participants that the collective good was going to be something non-divisible doubled contributions to about 80%. Only first-year economics graduate students behave very differently, since, on average, they only contributed 20% to the collective fund and a significant number of individuals in this group tried to free ride completely.

For consistency, we include only the twenty-seven countries that were OECD members at the time of ratification of the Kyoto protocol (before 2000) and excluding that is, six countries that joined after 2010. (Chile, Estonia, Israel, Slovenia, Latvia, and Lithuania). The countries included in the analysis are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Turkey, UK, and US.

We determined a leader's profession by looking into his main occupation prior to becoming a professional politician. We classified as "Politician/State Official" those who went directly from school/university to becoming politicians or state officials, or who did not have a clear professional trajectory before becoming politicians (e.g., worked different jobs for a few years). We grouped professions into eight groups: Businesspersons, law-related, college lecturers, politician/civil servants, scientists/science-related, other professions (see Table A1 in the Appendix).

Our sample includes 156 leaders for a total of 681 leader-year observations (see Table 1). Our average leader is 55 years old, governed for 4 years, and has been in politics for 30 years (Table 2). Most leaders are lifetime politicians or civil servants (33%), but there is also a good representation of businesspeople (12%), lawyers (14%), professors (13%) and scientists (15%) (Table 1). The grand majority of leaders are men (92% - only 13 leaders in our sample are women GDP and population data were taken from the World Bank Databank. For carbon emissions, measured in tonnes per year, we used Global Carbon Project (2019) data. For renewable energy, we created a new consolidated Renewable Capacity dataset, merging data from the International Energy Agency (IEA), which has data available from 1980 to 1999, with data from the U.S. Energy Information Administration (EIA), which has complete data from 2000 onwards (before it was only measuring hydroelectric capacity). We indexed both datasets to the year 2000 to do this.

Table 1. Frequency analysis of qualitative variables in the model, 1992-2017

	Overall		Between Country		Between Leader	
	n	%	**n**	%	**n**	%
Gender						
Men	632	92.89	27	100.00	143	91.61
Women	49	7.11	9	33.33	13	8.39
Occupation						
Business	77	11.18	15	55.56	19	12.26
Law	110	15.97	16	59.26	23	14.19
College Lecturer	78	11.32	12	44.44	20	12.90
Politician/civil servant	237	34.40	22	81.48	52	33.55
School Teacher/physician	21	3.05	6	22.22	7	4.52
Economist	35	5.08	7	25.93	8	4.52
Scientist/Science related	33	14.08	7	59.26	24	5.16
Other	90	4.93	14	18.52	5	12.90
Children						
No	56	8.13	9	33.33	12	7.74
Yes	625	91.87	27	100.00	144	92.26
Political orientation of the party						
Left-wing	260	37.74	25	92.59	61	39.35
Centre	31	4.50	4	14.81	9	5.81
Right-wing	390	57.76	27	100.00	86	54.84
Ruling with majority						
No	515	75.91	27	100.00	120	76.77
Yes	166	24.09	15	55.56	36	23.23
Ruling in coalition						
No	205	29.75	17	62.96	40	25.81
Yes	476	70.25	25	92.59	116	74.19
# observations	681		27		156	

Note: *Between-Country* values indicates how many countries have been ruled by a leader with a specific characteristic. For instance, 100% (27) of the countries in our sample have had a man as a ruler at least once, while 33% (9) of the countries have had a woman as a ruler at least once. *Between-Leader* values indicates the frequency distribution of the leader characteristics across countries. For instance, 92.2% (141) of the leaders are men, while 8.4% (13) of the leaders are women.

Table 2. Descriptive statistics of the continuous variables in the model, 1992-2017

	n	**Mean**	**Std. Dev.**	**Min**	**Max**
Age	681	55.54	8.50	35	78
Years in Office	681	29.71	10.24	0	61
Years in politics	681	3.96	2.79	1	13
GDP/1,000,000 (2010 US $)	681	1,430,000	2,670,000	7,920	17,000,000
GDP per capita	681	35,454	17,311	5,632	91,566
Population/1,000	681	40,900	59,400	261	323,000
% Urban population	681	75.90	10.96	49.13	97.961
Installed renewable capacity (million Kw)	681	18.12	27.90	0.072	214.472
CO2 emissions (kt)	681	458,000	1,060,000	2,263	6,130,000

Empirical model

Basic model

To estimate the impact of leaders' characteristics on CO2 emissions and installed renewable energy capacity, we use a linear model with country fixed-effects, while also controlling on other demographic and economic country characteristics. We are interested in measuring the average effect of leader characteristics, with special attention to leader's profession, on CO_2 emissions and renewable capacity. Our basic specification is:

$$\ln Y_{it} = \sum_k \beta_k Z_{jit} + \sum_m \lambda_m X_{it} + \delta_t + \mu_i + \varepsilon_{it} \quad (1)$$

where Y_{it} is the outcome variable, CO_2 emissions or renewable capacity, for country i in year t, Z_{jit} are a set of socio-economic characteristics for leader j, ruling country i in year t, and X_{it} are country controls. β_k and λ_m are the set of parameters associated to our explanatory variables to be estimated, and ε_{it} is a random error term. δ_t are year fixed-effects (t), which are estimated by including year dummies, and μ_i are and country (i) fixed-effects.

The matrix X_{it} contains the following country level variables: logarithm of the GDP and of the total population, and the percentage of urban population. Controlling for national income (GDP), our model isolates the effect of leaders on climate policy and outcomes, and controls for the possible effect of income on both emissions and types of leaders elected (e.g. higher income countries emitting more and electing specific types of leaders). Reverse causation is a limited concern for our research question. Undoubtedly, there will be a share of the electorate that may prioritize the candidates' position towards carbon emissions or his/her commitment to renewable energy, however, this group of potential voters is not big enough at least during our sample period, to be likely to affect the types of leaders elected.[4] There are

[4] Using the 1996 National Election Study data, Guber (2001) finds that despite environmental issues is associated by surveyed individuals as a strength of the Democratic Party, those issues seldom shape individual vote preferences. According to the Eurobarometer published in 2016, on average, only 6% of the European citizens thought that climate change is one of the most important issues facing Europe.

278 also no obvious attributes that would both affect the electability of say businesspersons
279 compared to other professions, and make them less likely to adopt stringent climate policy.
280 And to the extent that there are say distinctive psychological dispositions in leaders from
281 certain professions, this does not undermine our objectives, which is to document such
282 differences and their impacts, rather than identify their potential sources, which we see as a
283 question for further research.

284 We address to an extent other sources of unobserved heterogeneity across countries,
285 such as economic, cultural or political factors omitted that affect both climate policy/outcomes
286 and the pool of candidates or voters' choice between politicians with different characteristics
287 with the consideration of the country fixed-effects which eliminate bias from unobserved time-
288 invariant factors - such as location, geography or culture - that differ among countries but do
289 not change over time. We also include year fixed-effects by including year dummies, which
290 control for changes in the outcome variables over time but do not differ across countries (say
291 global oil prices, or a global macro-economic shock). The omission of the country fixed-effects
292 may jeopardize the strict exogeneity assumption if unobserved time-invariant country-level
293 factors captured by u_i are correlated with the covariates in equation (1). Strict exogeneity is a
294 necessary condition in order to obtain consistent/unbiased estimates.

295 The matrix Z_{jit} is composed by our explanatory variables of interest, i.e. a wide variety
296 of leader socio-demographic characteristics: leader's profession, having children, gender, age,
297 years in politics, years in office, ideology of the party, type of government (majority, coalition).

298 To estimate equation (1), and get rid of the unobserved heterogeneity across countries,
299 we resort to the following equation:

300

301 $$(\ln Y_{it} - \ln \overline{Y}_i) = \sum_k \beta_k (Z_{k,jit} - \overline{Z}_{k,i}) + \sum_m \pi_m (X_{m,it} - \overline{X}_{m,i}) + \delta_t + (\varepsilon_{it} - \overline{\varepsilon}_i) \qquad (2)$$

302

In equation (2), each variable is demeaned with its time-average in each country. In this setting, the identification strategy hinges around the within-country variation of the outcome and the explanatory variables around their means.

3.2. Total effects of leader characteristics

In order to estimate the total effect of the leader characteristics on our outcome variables, we take into account the concept of "bad controls" (Angrist and Pischke, 2009). They define as a "bad control" a control variable that is itself an outcome variable, while a good control is a variable that has been fixed at the time when the variable of interest is determined. A classic example is the discussion of whether occupations should be included or not in wage equations if we want to estimate a precise value of the returns to education. Education determines the type of occupation achieved, therefore some of the effect of education on wages is indeed captured by occupation coefficients. The problem can be analytically formalized in the following way. Let's rewrite equation (2) as follows:

$$\ln Y_{it}^{*} = \beta_0 + \beta_1 Z_{1,jit}^{*} + \beta_2 Z_{2,jit}^{*} + \beta_3 Z_{3,jit}^{*} + \pi X_{it}^{*} + \delta_t + \varepsilon_{it}^{*} \quad (3)$$

Where $Z^{*}=(Z^{*}_1, Z^{*}_2, Z^{*}_3)$ are three leader characteristics that affect our outcome variables (CO2 emissions or renewable capacity). Suppose that we are especially interested in measuring the impact of Z^{*}_1 on Y^{*}, and that Z^{*}_1 has an impact on Z^{*}_3 but not on Z^{*}_2, then we can write:

$$Z_{3,jit}^{*} = \gamma_0 + \gamma_1 Z_{1,jit}^{*} + \gamma_2 Z_{2,jit}^{*} + e_{it}^{*} \quad (4)$$

Replacing equation (4) in equation (3) and rearranging yields:

$$\begin{aligned} \ln Y_{it}^{*} &= (\beta_0 + \beta_3\gamma_0) + (\beta_1 + \beta_3\gamma_1) Z_{1,jit}^{*} + (\beta_2 + \beta_3\gamma_2) Z_{2,jit}^{*} + \lambda X_{it}^{*} + \delta_t + (\varepsilon_{it}^{*} + \beta_3 e_{it}^{*}) \\ \ln Y_{it}^{*} &= \lambda_0 + \lambda_1 Z_{1,jit}^{*} + \lambda_2 Z_{2,jit}^{*} + \pi X_{it}^{*} + \delta_t + \upsilon_{it} \end{aligned} \quad (5)$$

According to equations (3) and (5), some of the effect of Z^*_1 on Y^* will be an indirect effect exerted via Z^*_3. More specifically, the direct effect of Z^*_1 on Y^* is picked-up by β_1, while the indirect of Z^*_1 on Y^* via Z^*_3 is picked up by $\gamma_1\beta_3$. In this setting, if we want a straightforward estimation of the total effect of Z^*_1 on Y^*, then we should exclude Z^*_3 from the model.

According to the citizen-candidate theory, there is a political competition and selection is a game between citizens competing to reach and hold office (Osborne and Slivinski, 1996). This means that many of interactions among individual characteristics we can observe in society can be extrapolated to politicians. For example, empirical evidence shows that women are less likely to choose or be chosen for certain occupations and or that women having 'successful' working careers are less likely to have children. Therefore, in order to estimate the total effect of leader's gender on our outcome variables, occupation and children should not be included as controls. Analogously, it can also be observed a bidirectional relationship between age and the number of years in politics. On the one hand, years in politics increase with age; on the other hand, the number of years in politics (experience) determines the age at which a politician takes office. That is, more experienced politicians are more likely to be elected. Age also determines the achievement of certain occupations, for example, occupations as scientist or university professor are achieved at older ages than other less qualified occupations, or than professional politicians who start in politics at very young ages. Thus, age is a bad control when we estimate the impact of years in politics, while the latter variable and occupation are bad controls when we estimate the impact of leader's age on our outcome variables.

All the associations mentioned above are supported by our data. The estimates of the effect of leader characteristics on our outcome variables (CO2 emissions and renewable capacity) have into account all these relationships across variables. Therefore, we estimate the total effect for each leader characteristic omitting those other characteristics used as covariates that can be also affected by this specific leader characteristic.

Empirical results

The impact of leader's profession: Businesspersons and economists are bad for the climate

Tables 3 and 4 present our results. In Table 3, we report the impact of leader's profession on emissions and renewable energy, while controlling for other leader characteristics (gender, age, etc), other country-level variables of interest, country fixed-effects and year fixed-effects. In Table 3, occupations are dummy variables, which are all included simultaneously, except the base category (businesspersons) - therefore each occupation is compared with businesspersons. Table 4 instead estimates one model for each occupation, therefore, compares each profession with all the rest (Columns 1 and 5).

The first general conclusion from our results is that leader characteristics matter: several characteristics of political leaders have statistically significant effects on either or both carbon emissions and renewable energy deployment. However, profession stands out as the trait where differences really matter (Tables 3 and 4). And it is businessmen that score worst (we use the word business 'men' here literally –all leaders with business background in our sample are men). Years in which businesspersons are governing are associated with 5% more emissions and 28% less renewable energy capacity (Table 4).

When we compare leaders coming from other professions with businesspersons, we find considerable differences (Table 3). Compared with businesspersons, lawyers and university professors are associated with 6% less emissions, politicians/civil servants 5%, scientists 3%, and school teachers/physicians as much as 16% (though we should treat this last result with caution, as only 7 leaders or 3% of leader years in our sample correspond to teachers/physicians – Table 1). The only category almost as bad as businesspersons are economists with 3% more emissions than the rest of the occupations (Table 4), and no statistically significant difference from businesspersons (Table 3).

One might think that the worst performance of businesspersons in climate outcomes is not surprising. But the businessmen in our sample do not fare any better in terms of renewable

382 energy development, a dynamic economic sector which one would expect entrepreneurs to
383 support it more. Indeed, all professions do better than businesspersons, with differences
384 higher than 20%. School teachers/physicians and scientists stand out in terms of renewables:
385 years in which they preside are associated with 47% and 37%, respectively, more renewable
386 energy than years when businesspersons govern. The other professions also report quite
387 sizable differences with respect to businesspersons: lawyers (22%), college professors (19%),
388 and politicians/civil servants (28%) As with CO2 emissions, economists (and "other
389 professions") are the only ones who do not have statistically significant differences from
390 businesspersons in terms of renewable energy (Table 3). Comparing each profession with all
391 others (Table 4), we see that teachers/physicians score much better than others in terms of
392 both carbon emissions (years that they govern associated with 12% less emissions) and
393 renewable energy deployment (with 24% more capacity the years that they govern, followed
394 by scientists, 17%).

395 Our results confirm our hypotheses, and are also in line with what we know regarding
396 other policy outcomes from theory and previous studies. From the content and nature of their
397 job, focussed on caring and human health, it makes sense that teachers and doctors are more
398 concerned with curbing carbon emissions and in mobilizing renewable energy. Experimental
399 studies have shown that economists are more like to free ride in public good provisioning than
400 people from other backgrounds (Marwell and Ames, 1981). Features also of businesspersons
401 and economists that in the economics literature are found to be good for growth (Dreher et al,
402 2009), such as their focus on output or liberalizing reforms, may make businesspersons
403 potentially bad for the climate. For example, the emphasis of businesspersons or economists
404 on economic efficiency over broader social goals may make them more oriented to pursue
405 short-term growth at all costs, and less likely to undertake short-term costs or sacrifices
406 necessary for reducing carbon emissions. Likewise, liberalization in many cases has also meant
407 environmental deregulation, which might explain also differences between

businesspersons/economists and professions such as lawyers or lawmakers (politicians and civil servants).

Another possible channel of causality could be social, rather than directly related to personal or education attributes of leaders. It could plausibly be the case that strong business networks finance the election of people from their community (or economists), with the intention to promote a business-friendly agenda that might involve environmental deregulation. This merits further research. But note that this does not help explain the worse performance on businesspersons on renewable energy development, or the positive impacts of other professions, such as teachers or scientists on climate or renewables.

The impact of other leader's characteristics

Results regarding the impact of other leader characteristics are also shown in Tables 3 and 4. In Table 3, we show the results of the models including all leader's characteristics, while Table 4 tests also for the effect of these variables but without controlling for other leader characteristics – this is to check whether some variables that we included in Table 3 act as 'bad controls' upon others (see explanation in previous section). For example, if one checks the effect of gender controlling for profession, as we do in Table 3, then the effect from the concentration of women leaders in a particular profession (that might be good or bad for climate policy) is taken away. However, if gender determines the type of profession, some of the impact of leader's gender on CO2 emissions and renewable energy operates through occupation. For example, none of the female leaders in our dataset have previous experience in business, while female leaders tend to concentrate in occupations such as professional politicians and health care related professions. Table 4 then runs the regressions without any control to eliminate controls that possibly take away part of the effect of interest. In reality, we are interested on both types of information – the total, direct and indirect, impact of the leader

characteristics by excluding so-called "bad controls" (what is captured by Table 4), as well as the separate effects of the leader characteristics by controlling all covariates (Table 3).

Previous literature shows that female politicians are less corrupt or opportunistic (Brollo and Troiano, 2016), are more likely to support foreign aid (Hicks et al., 2016), and also are more prone to invest in infrastructures that are more related to the needs of their own gender (Chattopadhyay and Duflo, 2004). It is also observed that women prefer higher social spending than men (Lott and Kenny, 1999; Abrams and Settle, 1999; Aidt and Dallal, 2008, Svaleryd, 2009). This evidence supports the notion that female leaders should be good for climate mitigation, however, our results indicate the opposite. This result was somewhat surprising, but we tested different specifications (including running a test without Angela Merkel who accounts for 24% of all women leader-years in our sample to see if the performance of her presidency drives in any way the results), but the positive sign for females comes out strong and statistically significant (1% level) in all cases.

According to our results in Table 3, tenures of female governors are associated with higher levels of carbon emissions by a considerable 8%, though they have no discernible effect on renewable energy capacity. However, as we explained above, gender is highly associated with profession, therefore, it is likely that part of the effect of gender is taken away by profession. Indeed, results reported in Table 4 are somewhat different. We observe that once possible bad controls are excluded, the effect of women's tenures on carbon emissions falls by 3 percentage points, while their effect on renewables becomes positive with a 25% increase of deployment compared to men, statistically significant at 1%. This can be interpreted as indicating that a significant effect of women on emissions and renewable capacity operates through its relationship with other variables that we included in Table 3. We know for example that there are fewer women in business and more women that are teachers, professionals in the health sector or civil servants. It is then likely that some of the effect of a leader's profession on the outcome operates indirectly through gender. It makes sense then that taking out

variation in terms of professions, which is what we do in Table 3, the effect of women on emissions increases while that in renewables is dampened.

Gender does not have to affect policy preferences for innate biological reasons, but through a range of acculturation processes, including training or profession. Table 4, where such factors are not controlled for, gives them a better sense of differences between women and men, as they stand by the time they are leaders. Even so, we see that the negative effect of women on emissions remains statistically significant and considerable (5% more emissions). The small number nonetheless of women leaders in our sample means our finding should be treated with caution, and explored further by testing gender differences in environmental policies in samples where there are more women leaders, such as for example mayors. Still, the result is interesting as it is prima facie inconsistent with the rest of the literature that finds women less prone than men to short-term, strategic political-electoral thinking (Brollo and Troiano, 2016), something that should favour strong action on climate. Experimental studies too suggest that once in power the choices women make are more socially oriented than those of men (Gneezy et al., 2003; Song et al., 2004). One possibility is that such pro-social/altruistic preferences could be dominated by other factors, where women may be less prone to take action that is good for the climate.

One potential explanation for the positive link between female leadership and CO2 emissions could be the so called "Queen Bee-phenomenon", according to which women leaders in male-dominated organizations tend to succeed by resembling men and distancing from preferences associated with women (Derks et al., 2016; Faniko et al., 2017). This would work the opposite way offsetting possible altruistic preferences for climate policy. A Queen-bee effect is a plausible hypothesis that could be explored with further qualitative/case-study analysis, though what is striking in our result is not that just women resemble men in climate (in)action, but that they actually perform worse, an intensified Queen-bee effect of a sorts. What requires further study is also why the effect of women on renewable energies would go

485 in the opposite direction to that of carbon emissions. True, as we noted there is no reason why
486 a leader cannot increase during her mandate both renewable energy deployment and carbon
487 emissions, given that the scale of renewable energy is still too small to make a difference. Still,
488 it is not directly clear why would women differ in this to men, assuming that this result is due
489 to a systematic difference.

490 To the best of our knowledge, there is no much evidence about the impact of age, years
491 and politics and years in office on policy outcomes, therefore we cannot build any hypotheses
492 based on previous evidence. However, it seems plausible that in terms of age and experience,
493 we might expect younger politicians to take a longer-term view and hence favour more
494 stringent climate action. Older politicians though might care more about their legacy than
495 short-term political expedience, and they might be more likely to care about the future of their
496 descendants than younger politicians. In this line, we estimate statistically significant impacts
497 (at 5% level) for leader's age and years in politics - however, we find this impact to be generally
498 fairly small.

499 To comment on the impact of age and years in politics, we think that Table 4 is probably
500 in this case a better guide than Table 3, since the age and years in politics naturally co-vary
501 and hence controlling for one while testing for the other, takes away some of the relevant
502 variation of both variables. According to the estimates in Table 4, age associates with reduced
503 emissions (Column 3), 0.1% less emissions for each extra year of age (that is 1% less emissions
504 per decade of age difference). However, no discernible effect on renewable energy is observed
505 (Column 7). As a minimum, we can conclude that our results do not confirm an expectation
506 that younger politicians would care more about the climate. While in principle a leader's
507 attitude towards the future could play a role in climate policy preferences (younger politicians
508 more concerned with longer-term impacts, both from a purely opportunistic perspective since
509 they might be around for longer, and pay the consequences of their actions, and from a

generational perspective caring more about later impacts), our research does not provide evidence in support of this hypothesis.

Years in politics has a statistically significant but small negative effect on CO2 emissions (Column 4), and only after a certain number of years in politics since in this specification only the quadratic polynomial, but not the linear, has turned out to be statistically significant. However, the impact of years in politics on the deployment of renewable energy is much more important. The estimated impact is inverted U-shaped, that is, positive but decreasing (Column 8).

Regarding the variable 'years in office', we are reluctant to draw any generalizing conclusions about seasoned versus 'fresh' politicians. How long a politician stays in power, instead, seems to make a considerable difference, leaders in first term associated with lower emissions, while leaders who have stayed more than 8 years have significantly higher emissions compared to those with shorter mandates (Table 3). One may interpret this as fresher leaders starting with better intentions, an effect which over the years get watered down.

Finally, a generational perspective is not observed in the case of parenthood. Parents, that one could expect them to care more about the longer-term impacts of climate change, do not seem to have discernable differences on either carbon emissions or renewable energy from non-parents (Table 3).

530 **Table 3. Determinants of Carbon emissions and renewable energy development, 1992-2014, 27 countries**

	Log(CO_2)	Log(renewable)
Business/Entrepreneur (Base category)		
Law	-0.0620***	0.217***
	(0.0149)	(0.0664)
College lecturer	-0.0640***	0.191***
	(0.0146)	(0.0664)
Politician/civil servant	-0.0512***	0.279***
	(0.0117)	(0.0532)
School Teacher/physician	-0.158***	0.467***
	(0.0212)	(0.0962)
Economist	-0.0159	0.0463
	(0.0186)	(0.0826)
Scientist/Sciences related occupation	-0.0326**	0.370***
	(0.0137)	(0.0612)
Other occupations	-0.0415**	0.0628
	(0.0199)	(0.0906)
Year 1-4 after being elected (first mandate)	-0.0563***	0.00259
	(0.0133)	(0.0604)
Year 5-8 after being elected 1st time (second mandate)	-0.0367***	0.000259
	(0.0133)	(0.0600)
Have children (yes/no)	0.00545	-0.111
	(0.0149)	(0.0677)
Female	0.0793***	0.0815
	(0.0154)	(0.0702)
Age	-0.0149***	0.00455*
	(0.00467)	(0.00263)
Age square	0.000123***	
	(4.19e-05)	
Years in politics	0.00395***	-0.00499**
	(0.00146)	(0.00200)
Years in politics square	-7.71e-05***	
	(2.67e-05)	
Left party	0.0191**	-0.0591*
	(0.00776)	(0.0351)
Governing in majority	0.0455***	-0.168***
	(0.0111)	(0.0498)
Governing in coalition	0.0159	-0.143***
	(0.0119)	(0.0528)
log(GDP)	0.406***	1.071***
	(0.0415)	(0.183)
% of urban population	0.0116***	0.0373***
	(0.00166)	(0.00753)
log(population)	1.694***	-3.980***
	(0.0888)	(0.397)
Constant	-20.58***	36.02***
	(1.449)	(6.275)
Observations	681	681
R-squared	0.685	0.730
# Number of countries	27	27

531 Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 4: Estimates of the effect of selected leader characteristics omitting possible "bad controls".

	Log(CO_2)				Log(Renewable)			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Business/Entrepreneur	0.0510***				-0.276***			
	(0.0112)				(0.0505)			
Law	-0.0164				-0.00299			
	(0.0102)				(0.0465)			
College lecturer	-0.0265**				-0.0198			
	(0.0118)				(0.0540)			
Politician/civil servant	-0.00698				0.0938***			
	(0.00790)				(0.0356)			
School Teacher/physician	-0.118***				0.242***			
	(0.0190)				(0.0883)			
Economist	0.0326**				-0.187**			
	(0.0163)				(0.0735)			
Scientist/Sciences related occupation	0.0173				0.166***			
	(0.0107)				(0.0483)			
Other occupations	0.0292*				-0.174**			
	(0.0170)				(0.0779)			
Female		0.0494***				0.253***		
		(0.0139)				(0.0629)		
Age				-0.00102**			0.00158	
				(0.000478)			(0.00217)	
Years in politics			0.00206					0.0313**
			(0.00132)					(0.0155)
Years in politics square			-4.76e-05**					-0.00123**
			(2.28e-05)					(0.000550)
Omitted variables "Bad controls"	None	Occupation, children	Occupation, children, age	Occupation, children, years pol.	None	Occupation, children	Occupation, children, years pol.	Occupation, children, age

Note: All models include all other controls included in table 3;
Marginal effects pick-up the total effect of each leader characteristic.
The coefficients associated to professions are estimated in separate models, that is, on model for each profession
Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Discussion and Conclusions

Our research is in line with what the related literature in economics has shown, and confirms that leader features, as in many economic policy outcomes, have a discernible impact on environmental policy outcomes as well. As we hypothesize in this paper, and in line with previous research regarding other policy outcomes, businesspersons, and to a lesser extent, economists, are definitely bad for climate action. Medical doctors and teachers do better and like scientists they are good for developing renewable energy. Unlike what one would expect, women are not better than men regarding CO2 emission, though women tend to promote the deployment renewable energy much more than men. Age or experience have small effects. Our results overall indicate that electing leaders with the right characteristics might be a small, but necessary, step in making progress with climate mitigation. That is, voters who want to see real action on climate action should give extra consideration to the professional background of the candidates.

In our empirical analysis, we use a country fixed-effects model. This means that the identification strategy hinges on linking within-country variations in CO2 emission and in the deployment of renewable energies with within-country variations of political leaders characteristics ruling the country. This implies that the size effect is taken away, that is, countries responsible of a higher share of world global emissions do not have a higher incidence in our results than smaller economies responsible for a smaller share of global emissions. This circumstance makes the link between our outcome variables and leaders' characteristics we estimate here more robust. Analogously, despite citizens' concerns regarding climate change has increased in recent years, we think that during our sample period (1992-2017) leaders' climate change positions regarding environmental policies during electoral campaigns do not seem to be yet crucial in deciding whether they are elected or not.

562 Therefore, our results are not likely to be biased due to reverse causality, something that
563 strengths the causal relationship we estimate here.

564 Even though our results indicate that the impact of leader's characteristics, especially
565 his/her profession, is strong and sizeable, our research has certain limitations that should be
566 taken into consideration. First, there are idiosyncratic effects that may be missed by research
567 such as ours focussed as it is on systematic patterns. The antipathy of President Trump for
568 example towards climate mitigation action is probably not reduced to his experience as a
569 businessperson only. However, this type o personality traits are generally unobservable for
570 the researcher. Second, the fact that leader characteristics have, other factors equal, an impact
571 on emissions or renewable energy development does not mean that these impacts are stronger
572 than other macro-economic, technological, or ideological factors. What it means is that leader
573 characteristics matter and that electorates concerned with climate change should take them
574 into consideration when deciding who to vote, alongside the ideologies and explicit
575 statements and promises of the leaders and their parties.

576 The main contribution of our research is that it addresses for the firs time the gap in
577 the literature on possible links between political leaders and environmental outcomes, which
578 to the best of our knowledge is virtually inexistent. We think the above results could be better
579 treated as hypotheses for further research, which could mobilize case studies on leaders with
580 interviews, surveys or regression analyses at lower levels of leadership (e.g. regional
581 governors or mayors). Further research could shed light on whether it is the lack of specialized
582 knowledge or lack of training on climate issues in business/economic curricula, or the general
583 profit-first norms cultivated in the business/economics world that drive such differences.
584 Alternatively, it could be proximity or alliances to industrial or fossil fuel interests developed
585 in the professional careers of the leaders that make them reluctant to undertake later action on
586 climate change. Future research should also consider possible 'spill-over' effects leaders in
587 core countries might have on the emissions of others and which are not the object of our

588 research (think of the effect of a Trump presidency on the emissions of other countries given
589 the withdrawal of the US from the Paris agreement). A businessperson elected in the US, the
590 hypothesis is, might have a bigger impact on global emissions, than say a businessperson in
591 Greece. Second, it would be important to look whether the emergence of a new breed of
592 authoritarian/populist leaders and parties changes in a significant way the associations we
593 found here.

594 We cannot talk about 'policy' implications of our findings, but there are clear 'political'
595 implications. Our research suggest that voters who care about the climate should pay attention
596 to candidates' professional backgrounds, in addition to the candidate's party's ideology or
597 specific positions on climate change and policy. Pressure groups also who want to push for
598 climate mitigation legislation or funding should know that times where for example the
599 governors are scientists or doctors are times when they can be more ambitious and push for
600 more action, perhaps even more than what the political affiliations or stated preferences of the
601 candidates suggest. Reversely, periods where the leaders are businesspersons or economists
602 are perhaps periods for more oppositional politics, and vigilance and pressure should be
603 maintained even if such leaders or their parties express pro-climate action preferences.
604

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Appendix

Table A1.
Leaders profession codification

	N
Businesspersons	
Bank Executive	5
Business Manager	44
Entrepreneur	28
Law	
Barrister	12
Lawyer	92
Legal Consultant	6
Lecturer/Professor	**86**
Politician/Civil servant	
Civil servant	37
Diplomat	16
Politician/State Official	183
State Company Official	1
Schoolteacher/physician	
Medic	6
Schoolteacher	15
Economist	
Auditor	6
Economist	29
Scientist/science related	
Engineer	12
Scientist	13
Other	
Clerk	26
ICT Professional	8
Farmer	6
Journalist	34
Unionist	9
Worker	3
Airline Steward(ess)	4