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RESEARCH ARTICLE

Do perceptions of international climate policy stimulate or discourage voluntary climate protection activities? A study of German and US households

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ABSTRACT

From a theoretical perspective, the effect of international climate policy on individual willingness to take up climate protection efforts is ambiguous. An effective international climate policy may motivate individuals to increase their voluntary efforts to mitigate global warming (crowding-in). However, if individuals perceive international climate policy to be effective, they may decide to scale back their own voluntary climate protection activities (crowding-out). Relying on data from representative household samples from Germany and the US, this article empirically explores the relation between individual perceptions of climate policy and their planned adoption of six climate protection activities. It also tests the effects of a 'warm glow' motivation and whether this effect varies with the perceived effectiveness of international climate policy. The econometric analyses provide suggestive evidence that higher perceived justification and effectiveness of international climate policy crowd in voluntary individual climate protection activities in the US and Germany. In both countries, these activities are also positively related to the warm glow indicator, confirming that feelings which go beyond pure altruism help explain individual voluntary climate protection efforts. For the German (but not the US) sample, the effect of warm glow is stronger when international climate policy is believed to be ineffective.

Key policy insights

- More effective international climate policy is expected to spur additional voluntary climate protection activities by individuals.
- Enhancing people's trust in the outcomes of international climate policy likely raises their engagement in voluntary actions.
- In some cases, policy failure may be somewhat compensated for by greater individual action, motivated by warm glow.

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1. Introduction

According to standard economic theory, individuals have virtually no incentive to voluntarily contribute to the provision of public goods such as climate protection (Holländer, 1990). Instead, rational individuals are expected to free ride on others' efforts. Nonetheless, the findings from numerous empirical studies suggest that individuals act not only in their own self-interest but also altruistically (Andreoni, 1989; Blanco, Lopez, & Coleman, 2012). In particular, intrinsic motivation may prompt individuals to care about both their own welfare and the welfare of others (Andreoni, 1988; Bergstrom, Blume, & Varian, 1986; Palfrey & Prisbrey, 1997). If individuals' behaviour is characterized by *pure altruism*, their own voluntary contributions to climate protection and the contributions of

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others are perfect substitutes. In this case, rational behaviour implies that additional contributions by others lead to a decrease in one's own contributions by an equal amount (complete *crowding-out*). In comparison, if individuals' behaviour is characterized by *impure altruism*, contributing to climate protection provides a direct personal benefit such as a feeling that might be described as a 'warm glow' (Andreoni, 1989). For example, empirical studies suggest that individuals are willing to pay a premium for electricity generated from renewable energy sources (Eikeland, 1998; Kotchen & Moore, 2007; Menges, Schröder, & Traub, 2005; Roe, Teisl, Levy, & Russell, 2001; Wüstenhagen & Bilharz, 2006). Like energy efficient technology adoption or purchasing fuel-efficient vehicles, buying green electricity is an *impure public good* because it provides both private benefits such as energy services and public benefits such as fewer greenhouse gas emissions, lower volumes of local pollutants or lower resource use. Because own contributions and contributions by others are not perfect substitutes, impure altruism implies that additional contributions by others lead to a less than one-to-one decrease in one's own contributions. In this case, crowding-out becomes incomplete.

Policy interventions may lessen or enhance individual intrinsic motivation to contribute to the public good. Neoclassical economic theory suggests that public spending for a public good leads to crowding-out effects (Andreoni, 1989; Bergstrom et al., 1986). The psychology and behavioural economics literature offers additional insights explaining crowding-out or, alternatively, also crowding-in effects. First, the literature on motivational crowding has shown that external circumstances such as policy interventions may crowd out or crowd in an individual's moral motivation to provide a public good (Bó, Foster, & Putterman, 2010; Frey & Stutzer, 2008; Nyborg & Rege, 2003). For example, command-and-control instruments, environmental taxes and emission certificate trading schemes tend to have a crowding-out effect, whereas legal interventions (e.g. punishments for non-compliers) and public information campaigns appealing to individuals' social responsibility produce a crowding-in effect (Frey & Stutzer, 2008; Nyborg & Rege, 2003). Second, experimental studies on the effects of fairness preferences such as conditional cooperation have found that individuals are more willing to contribute to charities and public goods if they observe, believe, or are informed that others are willing to do the same (Alpizar, Carlsson, & Johansson-Stenman, 2008; Fischbacher, Gächter, & Fehr, 2001; Khadjavi & Lange, 2013). By the same token, individuals will contribute less if they become aware that others are limiting their contributions (Fehr & Gächter, 2000). In this case, contrary to what neoclassical theory suggests, greater contributions by others will lead to crowding-in. Thus, from a theoretical perspective, the effect of international climate policy on individual willingness to take up climate protection efforts is ambiguous.

This article empirically investigates the relationship between individual perceptions of international climate policy and their planned adoption of six activities aimed at lowering energy-related CO_2 emissions and thereby mitigating global warming. Although crowding-in and crowding-out have been studied extensively in other contexts, so far the impact of individual perceptions of international climate policy on the adoption of climate-protection activities has not been explored.

Within the United Nations' climate negotiations, countries have recognized for many years that the global mean temperature must not rise by more than 2°C above pre-industrial levels if we are to limit the dangerous impacts of anthropogenic climate change to acceptable levels (UNFCCC, 2009). Since the adoption of the Kyoto Protocol in 1997, however, progress on a new climate agreement had been slow and faced several setbacks. For example, the United States never ratified the Kyoto Protocol and in 2011 Canada formally withdrew from it. In particular, progress was hampered by disagreement over the distribution of mitigation costs across countries. Industrialized countries (particularly the US) feared that greenhouse gas emission targets might negatively affect the competitiveness of their economies (Pauwelyn, 2007), while emerging and developing countries (e.g. China) feared that emission targets would inhibit their future economic growth ('cap on development') (Banerjee, 2012). After several futile attempts to come up with a Post-Kyoto climate agreement such as at the fifteenth Conference of the Parties (COP 15) in Copenhagen in 2009, countries eventually adopted the Paris Agreement at COP 21 in 2015 (UNFCCC, 2015).

The Paris Agreement confirms the 2°C target and calls for efforts to keep the global temperature increase below 1.5°C (UNFCCC, 2015). But like voluntary mitigation pledges countries had made earlier (at COP 15), the so-called Nationally Determined Contributions (NDCs), which form the basis of the Paris Agreement, are unlikely to be consistent with a path towards reaching the 2°C target (Höhne et al., 2012, 2017; OECD, 2015).[1] The gap between actual and required climate-protection efforts is likely to raise doubts about the effectiveness of current international climate policy in general, thereby undermining its legitimacy even for those not

questioning the existence of climate change. Thus, perceptions of the legitimacy and effectiveness of international climate policy not only affect the perceived relevance of international climate policy (Ščasný, Zvěřinová, Czajkowski, Kyselá, & Zagórska, 2017; Schleich, Duetschke, Schwirplies, & Ziegler, 2016; Schleich & Faure, 2017) but may also influence the willingness to engage in climate-protection activities at the individual level. For example, if individuals perceive international climate policy to be effective (e.g. because the Parties adhere to their commitments), purely altruistic individuals are expected to reduce their own contributions to climate protection (crowding-out). Alternatively, an effective international climate policy might motivate individuals who are characterized as conditional contributors to engage in climate-protection activities (crowding-in).

This article is the first to empirically explore the relationship between individual perceptions of the legitimacy and effectiveness of international climate policy and the adoption of several individual climate protection activities. The analyses include testing whether the 'warm glow' effect varies with the perceived effectiveness of international climate policy. The econometric analyses consider six climate-protection activities at the individual level, as detailed in the methodology below. To do so, unique data from representative surveys conducted simultaneously among citizens in Germany and the United States are employed. This also makes it possible to compare findings across two of the world's largest emitters, both of which play key roles in international climate policy.

The remainder of this article is structured as follows: Section 2 describes the data and the variables used in the econometric approach. Results are presented and discussed in Section 3. Section 4 concludes.

2. Methodology

2.1. Data

The data were collected using two representative online surveys of citizens aged 18 and older in the United States and Germany between May and June 2013.[2] Both samples were drawn from the Online Panel of the international market research company GfK (Gesellschaft für Konsumforschung). In Germany 1005 participants and in the United States 1010 participants completed the self-administered questionnaire. The questions referred to general assessments of climate change, specific voluntary climate-protection activities, assessments of international climate policy and climate negotiations, basic values and socio-demographic and socio-economic information. On average, US respondents took 30.4 minutes to complete the survey and German respondents took 31.8 minutes to do so. While self-selection bias cannot be totally ruled out, there is no evidence that the samples are not representative of the underlying populations of US and German adults based on the socio-demographic characteristics of age, income, education, marital status and household size.

2.2. Dependent variables

The participants in the survey were asked whether they planned to adopt any of the following climate-protection activities: Actions to save energy at home (e.g. regularly turning down heating or air conditioning, regularly switching off lights), using or purchasing energy from renewable sources (e.g. installing solar/photovoltaic systems or geothermal energy, purchasing green electricity), buying a car with lower fuel consumption, reducing car use and reducing the number of flights taken. Based on the binary structure of the response options, six dummy variables were constructed: *energy-efficient appliances, energy savings*, *renewable energy, fuel-efficient cars*, *reduced car use* and *fewer flights*. Table A1 reports the means for all variables across all respondents from Germany and the United States.[3] Accordingly, the percentages range from 36% for *fewer flights* in the United States to 87% for *energy savings* in Germany. Except for *fewer flights* and *reduced car use*, the shares of adoption are higher for Germany than for the United States.[4] Owing to the binary structure of these dependent variables, the econometric analyses involve binary probit models.

2.3. Main explanatory variables

To elicit participants' perceptions of international climate policy, the survey asked how strongly they agreed with particular statements on a symmetric scale with five ordered response categories.[5] The analyses rely on one

statement capturing legitimacy and two statements capturing the effectiveness of international climate policy. The indicator for the perceived legitimacy of international climate policy was based on responses to the question 'How important do you consider future international agreements to be for combating climate change?'[6] The dummy variable *legitimacy* takes on the value of one for the observations where 'rather important' or 'very important' is chosen as the answer. However, it needs to be pointed out that this question was posed only to the large majority of the respondents in both countries who stated that global climate change is already occurring or will occur in the future. Only these observations enter the econometric analyses. The first indicator for the effectiveness of international climate policy examines the extent to which respondents agree with the statement 'Commitments made at international climate negotiations will not be kept anyhow'. Climate negotiations are more effective if countries adhere to their commitments. In particular, this item also allows for conditional cooperation (e.g. reciprocity) to affect individual adoption of climate-protection activities. The dummy variable *broken commitments* is set equal to one if the respondent agreed 'very strongly' or 'rather strongly'.[7] The second indicator for the effectiveness of international climate policy is based on the statement 'How successful do you think the international agreements reached so far are in combating climate change?' The dummy variable *past success* equals one if the respondent agreed 'very strongly' or 'rather strongly'. Presumably, individuals perceive climate negotiations as more effective if they consider them to have been successful. In addition, *past success* is a proxy for perceived climate protection (i.e. the level of public good). According to Table A1, the percentages for *legitimacy* are fairly high, those for *broken commitment* are moderate and those for *past success* are quite low, but responses differed slightly across countries.

To capture the warm glow motivation, the combined dummy variable *warm glow* was constructed, taking the value of one if respondents agreed 'rather strongly' or 'very strongly' to the statement 'it makes me feel good to contribute to climate protection' or to the statement 'I feel responsible for making a contribution to climate protection'.[8] Table A1 suggests that the share of respondents exhibiting warm glow is slightly higher in Germany than in the United States. Finally, to capture the potential interplay between *warm glow* and *past success* the model includes the interaction term *warm glow* × *past success*.

2.4. Control variables

The econometric analysis includes a wide range of control variables, similar to those that have typically been included in analyses exploring household adoption of energy-efficient or renewable technologies (Ameli & Brandt, 2015; Mills & Schleich, 2012). The first group of control variables refers to the perceived contribution to climate protection and the financial consequences of the climate-protection activities. The dummy variable *effectiveness* takes the value one if the respondent believed the respective activity to contribute 'rather a lot' or 'a lot' to climate protection.[9] Similarly, the dummy variable *financial advantage* is equal to one if a respondent believed an activity provides 'rather financial advantages' for her or him personally.[10] To capture the effect of environmental preferences, the dummy variable *identification with green politics* is included, which equals one if a respondent 'strongly' or 'rather strongly' identified herself with green politics.[11] *Effectiveness, financial advantage* and *identification with green politics* are expected to positively affect the adoption of climate-protection activities.

The third group of control variables captures the socio-demographic characteristics of the respondents. The dummy variable *high household income* is equal to 1 if the household monthly net income of the respondent is above the median category of the national sample (i.e. at least € 3000 in Germany and at least $ 4000 in the US). Similarly, the dummy variable *higher education* equals one if the respondent is qualified to pursue a degree in higher education (i.e. having earned a high-school diploma in the United States or an 'Abitur' in Germany). *Age* is measured in years and varies between 18 and 85 in the United States and between 18 and 89 in Germany. The dummy variable *female* is equal to one if the respondent is a woman. The *number of children* varies between zero and eleven in the United States and between zero and five in Germany. The dummy variable *living together* takes the value of one for the respondent's marital status is 'living with a partner' or 'married' and zero otherwise.

The final group of control variables reflects regional heterogeneity. For the United States, the specification includes the dummy variables *west, midwest, northeast* and *south* (the latter is omitted and treated as the

base category in the econometric analysis). For Germany, the model includes the dummy variable *west* for respondents living in Western Germany.

Table A1 reveals that the share of respondents identifying themselves with green politics is higher for Germany than for the United States. US respondents are slightly older, have more children, appear better educated and are more likely to have an above-median income compared with German respondents.

3. Results

For Germany, the estimation results appear in Table 1, and for the United States they appear in Table 2. The main area of interest for this study is the impact of the respondents' perceptions of international climate policy. The estimated parameter for *legitimacy* is positive and significantly different from zero for the adoption of energy-efficient appliances and of fuel-efficient cars in both countries, and also of energy savings in Germany. Similarly, the estimated coefficient for *broken commitment* is negative and statistically significant for *renewable energy* in both countries, and also for *energy savings*, *energy-efficient appliances* and *fuel efficient cars* in the United States. *Past success* is positively and statistically significantly related to planned climate-protection activities in Germany only, i.e. with *renewable energy*, *fuel-efficient cars* and *fewer flights*. Among the climate-protection activities considered, only *reduced car use* in both countries and *fewer flights* in the United States are not significantly related to the perception of climate policy. On the basis of Wald tests, the null hypothesis that the three parameters are jointly zero can be rejected at common significance levels for all models but for the models with *reduced car use* in both countries and with *fewer flights* in the United States.

Table 1. Estimated parameters in the binary probit models for Germany (robust z-statistics in parentheses).

Explanatory variables	Energy-efficient appliances	Energy savings	Renewable energy	Fuel-efficient car	Less driving	Fewer flights
Legitimacy	0.39**	0.49***	0.14	0.45***	0.21	−0.29
	(2.28)	(2.64)	(0.85)	(2.75)	(1.16)	(−1.30)
Broken commitment	0.10	0.03	−0.27**	−0.14	−0.05	−0.19
	(0.71)	(0.17)	(−2.14)	(−1.11)	(−0.41)	(−1.21)
Past success	0.41	−0.25	0.90*	1.10**	0.09	0.87**
	(0.73)	(−0.50)	(1.96)	(2.15)	(0.21)	(2.03)
Warm glow	0.12	0.03	0.65***	0.48***	0.61***	0.54**
	(0.75)	(0.16)	(4.73)	(3.41)	(4.25)	(2.56)
Warm glow × past success	−0.69	−0.46	−1.22**	−1.52***	−0.37	−0.95*
	(−1.16)	(−0.85)	(−2.43)	(−2.75)	(−0.79)	(−1.90)
Green	0.23	0.04	0.48***	−0.02	0.13	0.17
	(1.56)	(0.24)	(3.66)	(−0.13)	(0.97)	(1.10)
Age	−0.00	−0.02**	−0.02***	0.00	0.01	0.01
	(−0.35)	(−2.57)	(−3.02)	(0.23)	(1.26)	(0.83)
Female	0.11	0.21	0.07	−0.00	−0.12	0.28*
	(0.87)	(1.48)	(0.58)	(−0.01)	(−0.95)	(1.83)
Children	0.03	−0.02	0.01	0.01	0.05	0.19**
	(0.40)	(−0.33)	(0.24)	(0.24)	(0.89)	(2.48)
Live together	0.06	0.29*	0.30**	0.01	0.01	0.13
	(0.45)	(1.96)	(2.43)	(0.08)	(0.04)	(0.82)
High education	0.02	0.18	0.10	0.00	0.00	0.02
	(0.17)	(1.28)	(0.81)	(0.03)	(0.02)	(0.11)
High household income	0.05	−0.00	0.30**	0.37***	−0.13	0.14
	(0.39)	(−0.02)	(2.32)	(2.84)	(−1.00)	(0.86)
Effectiveness	0.04	0.18	0.27**	−0.00	0.31**	0.34**
	(0.32)	(1.26)	(2.05)	(−0.03)	(2.36)	(2.10)
Financial advantage	−0.01	0.35**	0.09	0.33***	0.21*	0.23
	(−0.07)	(2.20)	(0.66)	(2.70)	(1.72)	(1.56)
West	−0.02	0.16	0.33**	0.18	0.10	0.06
	(−0.14)	(1.03)	(2.36)	(1.28)	(0.71)	(0.31)
Constant	0.48	0.59	−0.34	−0.47	−0.82**	−1.38***
	(1.46)	(1.64)	(−1.09)	(−1.49)	(−2.39)	(−3.28)
Wald χ^2	15.51***	44.74***	101.1***	46.03***	53.52***	39.36***
Number of observations	643	639	590	598	532	341

* (**, ***) indicates that the coefficient is distinct from zero at the 10% (5%, 1%) significance level.

Table 2. Estimated parameters in the binary probit models for the United States (robust *z*-statistics in parentheses).

Explanatory variables	Energy-efficient appliances	Energy savings	Renewable energy	Fuel-efficient car	Less driving	Fewer flights
Legitimacy	0.12	0.41**	−0.10	0.34**	0.26	−0.24
	(0.70)	(2.21)	(−0.57)	(2.04)	(1.53)	(−0.98)
Broken commitment	−0.40***	−0.30**	−0.30**	−0.24*	0.04	−0.03
	(−2.74)	(−2.02)	(−2.34)	(−1.83)	(0.26)	(−0.17)
Past success	−0.45	−0.25	0.36	−0.13	−0.06	0.22
	(−1.30)	(−0.63)	(1.00)	(−0.36)	(−0.13)	(0.40)
Warm glow	0.90***	0.51**	0.71***	0.40**	0.07	0.16
	(4.48)	(2.44)	(3.78)	(2.05)	(0.36)	(0.62)
Warm glow × past success	0.00	−0.35	−0.22	−0.25	−0.18	−0.28
	(0.00)	(−0.84)	(−0.56)	(−0.63)	(−0.40)	(−0.49)
Green	−0.13	−0.29	0.25	−0.07	0.51***	0.48**
	(−0.71)	(−1.56)	(1.54)	(−0.46)	(2.88)	(2.33)
Age	−0.00	−0.00	−0.01**	0.01	−0.01	−0.00
	(−0.11)	(−0.29)	(−2.53)	(1.12)	(−0.90)	(−0.53)
Female	−0.09	0.04	−0.15	−0.10	0.13	−0.32
	(−0.60)	(0.27)	(−1.14)	(−0.73)	(0.89)	(−1.62)
Children	0.10	0.08	0.09	−0.02	0.06	−0.03
	(1.51)	(1.18)	(1.62)	(−0.44)	(1.06)	(−0.38)
Live together	0.04	−0.03	−0.23*	0.14	0.23	0.11
	(0.25)	(−0.21)	(−1.66)	(0.98)	(1.55)	(0.54)
High education	−0.27*	−0.20	0.03	0.25*	0.23	−0.10
	(−1.69)	(−1.17)	(0.20)	(1.75)	(1.48)	(−0.42)
High household income	0.51***	0.31**	0.36**	0.40***	0.13	0.31
	(3.38)	(2.01)	(2.57)	(2.90)	(0.86)	(1.45)
Effectiveness	−0.72***	0.08	−0.00	−0.38**	−0.16	0.12
	(−3.99)	(0.50)	(−0.01)	(−2.35)	(−0.92)	(0.59)
Financial advantage	0.45***	0.47***	0.46***	0.52***	0.74***	0.63***
	(2.70)	(2.74)	(3.14)	(3.65)	(4.58)	(3.28)
Northeast	−0.24	−0.59***	−0.14	−0.29	−0.40*	−0.04
	(−1.14)	(−2.71)	(−0.79)	(−1.56)	(−1.95)	(−0.15)
Midwest	−0.07	−0.27	−0.05	0.07	−0.28	0.32
	(−0.38)	(−1.29)	(−0.31)	(0.39)	(−1.56)	(1.25)
West	−0.48***	−0.70***	−0.14	−0.24	−0.48**	−0.09
	(−2.66)	(−3.62)	(−0.80)	(−1.36)	(−2.53)	(−0.41)
Constant	0.79**	0.76**	0.24	−0.28	−0.21	−0.32
	(2.22)	(2.04)	(0.75)	(−0.89)	(−0.58)	(−0.72)
Wald χ^2	78.28***	69.34***	75.41***	52.46***	48.61***	28.98***
Number of observations	503	510	453	486	422	224

* (**, ***) indicates that the coefficient is distinct from zero at the 10% (5%, 1%) significance level.

To assess the strength of the effects and to allow for a more meaningful interpretation of the results, the estimated average marginal and discrete effects are reported in Table A2 for Germany and in Table A3 for the United States. For example, if climate policy is considered to be justified, the propensity to adopt an energy-efficient appliance increases on average by 8 percentage points for US respondents and by 9 percentage points for German respondents. In general, Tables A2 and A3 document significant size effects, i.e. the effects of individual perceptions of climate change on the adoption of climate-protection activities are not just statistically significant, but also meaningful in a quantitative sense. In sum, the findings suggest that higher perceived legitimacy (for all respondents) and effectiveness (for respondents with low warm glow motivation in Germany) of international climate policy are positively related to the adoption of climate-protection activities. Thus, individuals in the United States and Germany who believe in the legitimacy of international climate policy are also more likely to voluntarily provide the global public good climate protection. Individuals in Germany who lack a warm glow motivation but believe in the success of international climate policy seem to be more prone to such voluntary contributions.

In both countries, the adoption of most climate-protection activities is, as expected, positively and statistically significantly related to *warm glow* for individuals who do not believe in the past success of international climate policy, but not for *reduced car use* or *fewer flights* in the United States and not for *energy-efficient appliances* or *energy savings* in Germany.[12] Thus, feelings of warm glow, which go beyond pure altruism, appear generally to

drive the adoption of climate protection activities in Germany and the United States, especially for individuals who are sceptical about the success of international climate policy. The estimated coefficient of the interaction term *warm glow* × *past success* is negative and statistically significant for three climate-protection activities in the German sample, but not in the US sample. However, as pointed out by Ai and Norton (2003) and further discussed by Greene (2010), for non-linear models (here binary probit models) the estimated parameter of the interaction term (here *warm glow* × *past success*) does not reflect the true estimated interaction effect and may be misleading. The interaction effects of *warm glow* and *past success* instead depend on the values of all explanatory variables. Following Greene (2010) the interaction effect of *warm glow* and *past success* is assessed by comparing the discrete probability effects of *warm glow* for low and high values of *past success* for the models with interaction terms.[13] Table 3 reports the findings for those climate-protection measures where the partial effects and the interaction term are statistically significant, i.e. for *renewable energy*, *fuel efficient cars* and *fewer flights* in Germany.

The results reported in Table 3 suggest that, for the three activities considered, the discrete probability effect of warm glow is positive when the success of previous climate policy is perceived to be low and negative when the success of previous climate conferences is perceived to be high.[14] Thus, for *renewable energy*, *fuel efficient cars* and *fewer flights* in the German sample the effects of feelings of warm glow and perceptions of climate policy appears to be interdependent.

Moreover, control variables were also found to be related to individuals' planned adoption of climate-protection activities. The estimated coefficient of the effectiveness of these activities is positive and statistically significant for half of the activities in the German sample, but negative for *energy savings* and *fuel-efficient cars* in the US sample. As expected, *financial advantages* has a significantly positive impact on the planned adoption of most climate protection activities in the United States, and on half of the activities in Germany. *Identification with green politics* is significantly positively correlated with one activity in the German sample only, and with two activities in the US sample.[15] *High household income* is found to significantly increase the propensity to adopt most climate-protection measures in the United States, and *renewable energy* and *fuel-efficient cars* in Germany. In comparison, Tables 1 and 2 suggest that *higher education* matters only in the US sample, where it is significantly positively related to *fuel-efficient cars,* but significantly negatively related to *energy savings*. If significant, the estimated coefficient on *age* is negative. In both countries, older people exhibit a significantly lower propensity to adopt renewable energies in particular. Gender is found to be significantly related only to *fewer flights*. Women in Germany and the United States plan to fly significantly less often than men. The number of children fails to be statistically significant for any activity. In comparison, *living together* is significantly positively related to *energy-efficient appliances* and *renewable energy* in Germany, but significantly negatively related to *renewable energy* in the United States. Regional effects are found to matter for most activities in the United States. In Germany, households living in former West Germany are found to be significantly more likely to adopt renewable energy only.

Table 3. Estimated average discrete probability effects of warm glow for varying levels of past success (German sample).

	Estimated probability	Difference between estimated probabilities
Renewable energy		
Warm glow = 0; past success = 0	0.50	0.22
Warm glow = 1; past success = 0	0.72	
Warm glow = 0; past success = 1	0.79	−0.17
Warm glow = 1; past success = 1	0.62	
Fuel-efficient car		
Warm glow = 0; past success = 0	0.66	0.15
Warm glow = 1; past success = 0	0.81	
Warm glow = 0; past success = 1	093	−0.25
Warm glow = 1; past success = 1	0.68	
Fewer flights		
Warm glow = 0; past success = 0	0.27	0.18
Warm glow = 1; past success = 0	0.46	
Warm glow = 0; past success = 1	0.58	−0.15
Warm glow = 1; past success = 1	0.43	

In summary, except for household income, the socio-demographic variables show only weak estimated correlations with the planned adoption of climate-protection activities. Some differences between the German and US samples can be observed for factors related to planned climate-protection activities. For example, for US respondents, the perceived past success of international climate policy generally appears less relevant, while conditional cooperation (reciprocity) and financial aspects seem more relevant compared with answers given by German respondents. Likewise, regional effects are obviously more relevant for the US sample than for the German sample. As a first caveat, it should be noted that these inferences are derived from a subset of the participants who agreed that climate change is already occurring or will occur in the future. Since this share is increasing globally (including also in the US), any potential bias this may cause should be small. Second, and arguably more relevant, the results rely on statistical correlations, which do not imply causality. This should also be kept in mind when interpreting the findings and deriving policy implications.

4. Conclusions

Do perceptions of international climate policy stimulate or discourage voluntary climate protection activities by individuals, through crowding-in or crowding-out?

The results of the econometric analyses provide suggestive evidence that higher perceived legitimacy and effectiveness of international climate policy crowd-in voluntary individual climate protection activities in Germany and the United States. For the US sample, in particular, believing that commitments made at international climate negotiations will not be kept reduces participants' propensity to adopt climate-protection activities. We interpret this as the effects of fairness perceptions such as conditional cooperation (reciprocity). Adoption of climate protection activities is higher for respondents from Germany (but not the US) who believe that previous climate conferences have been successful. In both countries, individual climate-protection activities are also positively related to feelings of warm glow, confirming that feelings which go beyond pure altruism help explain individual voluntary efforts to protect the climate. For the German (but not the US) sample, the findings offer evidence that this effect varies with the perceived effectiveness of international climate policy. More specifically, the effect of warm glow appears to be stronger when international climate policy is considered to be ineffective, thus suggesting that the effects of warm glow and perceived success of climate policy are interdependent. Because of feelings of warm glow and responsibility for climate protection, citizens appear to value their own contributions to the public good climate protection more highly when others fail to contribute. Thus, policy failure may be somewhat compensated by additional voluntary efforts motivated by feelings of warm glow.

These findings offer several insights for climate policy making. Above all, more effective international climate policy is expected to spur additional voluntary climate-protection activities by individuals, thus further contributing to the global mitigation effort which is necessary to achieve ambitious climate targets. In this respect, enhancing people's trust in the outcomes of international climate policy is likely to be effective, in particular to raise US citizens' engagement in voluntary actions. This emphasizes the challenge for international climate policy to forge credible international climate agreements, which include firm provisions for monitoring and enforcement. Similarly, those citizens (mostly in Germany) who perceive international climate policy, such as climate conferences, to be successful, will likely be motivated to engage in additional voluntary climate-protecting efforts. Key functions of international climate conferences include defining climate targets and identifying mechanisms to achieve those targets. To have the Paris Agreement be perceived as successful (and thus to motivate individual adoption of voluntary climate protection measures) would require strengthening the NDCs in order to increase the probability of achieving the 2°C target or even the 1.5°C target (Höhne et al., 2017).

Notes

1. Moreover, in June 2017 US president Trump announced that the US would withdraw from the Paris Agreement.
2. Thus, the survey period precedes the adoption of the Paris Agreement. After COP 15 in Copenhagen, where negotiations had failed to produce a new legally binding international agreement following the Kyoto Protocol, subsequent COPs nearly collapsed over issues such as burden-sharing of greenhouse gas mitigation efforts between developed and emerging economies

or the legal status of a new agreement. Arguably, respondents might feel more positive about international climate policy in the wake of the Paris Agreement's adoption.

3. Observations with missing values are dropped from the econometric analysis. The descriptive statistics on observations included in the econometric analysis differ very little from those reported in Table A1 for the full samples.
4. Questions on reducing car use and reducing the number of flights were addressed only to those respondents who reported a positive number of kilometers (miles) or a positive number of flights. As a consequence, the number of observations is lower for *reduced car use* and *fewer flights* than for the other activities.
5. Potential problems with this kind of scale include central tendency bias, acquiescence bias, and social desirability bias. These issues were addressed by 'don't know/no answer' options to distinguish true neutral from unsure responses, a scale design involving balanced keying, and closed-ended and 'neutral' wording of items.
6. The response categories were 'very unimportant', 'rather unimportant', 'neither important nor unimportant', 'rather important' and 'very important'.
7. In all cases we differentiated between 'very weakly', 'rather weakly', 'neither weakly nor strongly', 'rather strongly' and 'very strongly'.
8. We combine these two statements in one indicator to avoid problems of multicollinearity since responses to both questions are highly correlated.
9. The underlying question is 'How much do you believe the following measures contribute to climate protection' with the five ordered response categories 'very little', 'rather little', 'neither a little nor a lot', 'rather a lot' and 'a lot'.
10. The underlying question is 'In your opinion, do the following measures rather provide financial advantages (e.g. saving money, financial gains) or rather provide financial disadvantages (e.g. costs) for you personally' with the three ordered response categories 'rather financial disadvantages', 'neither financial advantages nor disadvantages' and 'rather financial advantages'.
11. The underlying statement was 'I identify myself closest with green politics' with the five ordered response categories 'very weakly', 'rather weakly', 'neither weakly nor strongly', 'rather strongly' and 'very strongly'.
12. To test this in light of the interaction effect with *past success* we calculated the average discrete probability effects (i.e. the change in the predicted probability of adoption) of *warm glow* if *past success* = 0 and if *past success* = 1 (and for the corresponding value of the interaction term).
13. Greene (2010) recommends a graphical analysis. Since warm glow and past success are both dummies, there are only four possible outcomes for the interaction term and a graphical analysis does not seem appropriate.
14. Wald tests suggest that these differences are also statistically significant at $p < 0.01$ for *renewable energy* and *fuel efficient cars*, and at $p < 0.1$ for *fewer flights*. For the other three measures the difference in the discrete probability effect is not statistically significant. We also considered a model without the interaction term. In this case, the difference in the estimated discrete probability effects was small and not statistically significant.
15. This might be due to problems of multicollinearity, i.e. high correlations with *warm glow*.

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Appendix

Table A1. Number of respondents and means for all variables.

	Germany		US	
Variables	Number of respondents	Mean	Number of respondents	Mean
Planned climate protection activities				
Energy-efficient appliances	969	0.84	952	0.78
Energy savings	973	0.87	965	0.81
Renewable energy	942	0.62	890	0.50
Fuel-efficient car	929	0.71	915	0.67
Reduced car use	805	0.62	739	0.62
Less flights	547	0.36	371	0.47
Legitimacy	871	0.86	698	0.73
Broken commitments	921	0.66	855	0.48
Past success	860	0.10	649	0.24
Warm glow	957	0.66	934	0.60
Identification with green politics	938	0.30	907	0.21
High household income	827	0.51	872	0.60
High education	1000	0.55	1006	0.68
Age	1005	41.13	1010	48.51
Female	1005	0.49	1010	0.53
Children	1005	0.95	1010	1.32
Live together	1002	0.63	1006	0.62
West	1005	0.79	1010	0.22
Midwest			1010	0.23
Northeast			1010	0.20
South			1010	0.35
Effectiveness				
Energy savings	964	0.61	924	0.61
Energy-efficient appliances	966	0.61	926	0.63
Renewable energy car	956	0.63	918	0.61
Fuel-efficient	949	0.67	875	0.60
Reduced car use r	958	0.63	925	0.59
Less flights	944	0.62	854	0.50
Financial advantage				
Energy-efficient appliances	956	0.81	919	0.76
Energy savings	956	0.62	914	0.73
Renewable energy	912	0.61	877	0.66
Fuel-efficient car	879	0.29	813	0.50
Less flights	834	0.56	805	0.56
Reduced car use	928	0.62	896	0.64

Table A2. Estimated average marginal and discrete probability effects for Germany (robust z-statistics in parentheses).

Explanatory variables	Energy-efficient appliances	Energy savings	Renewable energy	Fuel-efficient car	Less driving	Fewer flights
Legitimacy	0.085**	0.090***	0.045	0.129***	0.069	−0.103
Broken commitment	0.021	0.005	−0.085**	−0.042	−0.018	−0.068
Past success	0.089	−0.046	0.281**	0.316**	0.030	0.307**
Warm glow	0.025	0.005	0.204***	0.138***	0.204***	0.189***
Warm glow × past success	−0.151	−0.085	−0.382**	−0.437***	−0.125	−0.333*
Green	0.050	0.007	0.149***	−0.005	0.043	0.060
Age	0.000	−0.003**	−0.005***	0.000	0.002	0.002
Female	0.025	0.038	0.022	0.000	−0.039	0.098*
Children	0.006	−0.004	0.005	0.004	0.018	0.065**
Live together	0.013	0.054*	0.094**	0.003	0.002	0.045
High education	0.005	0.033	0.031	0.001	0.001	0.006
High household income	0.012	−0.001	0.092**	0.105***	−0.043	0.049
Effectiveness	0.009	0.033**	0.083**	−0.001	0.104**	0.118**
Financial advantage	−0.002	0.065	0.027	0.095***	0.071*	0.082
West	0.05	0.030	0.102**	0.052	0.035	0.019

* (**, ***) indicates that the effect is distinct from zero at the 10% (5%, 1%) significance level.

Table A3. Estimated average marginal and discrete probability effects for the United States (robust z-statistics in parentheses).

Explanatory variables	Energy-efficient appliances	Energy savings	Renewable energy	Fuel-efficient car	Less driving	Fewer flights
Legitimacy	0.027	0.083**	−0.031	0.097**	0.083	−0.086
Broken commitment	−0.090***	−0.060**	−0.099**	−0.069*	0.011	−0.011
Past success	−0.102	−0.049	0.120	−0.037	−0.017	0.078
Warm glow	0.200***	0.102**	0.232***	0.113**	0.022	0.058
Warm glow × past success	0.000	−0.071	−0.074	−0.070	−0.056	−0.100
Green	−0.029	−0.057	0.082	−0.021	0.159***	0.173**
Age	0.000	0.000	−0.004***	0.002	−0.002	−0.001
Female	−0.019	0.008	−0.051	−0.028	0.040	−0.114*
Children	0.022	0.016	0.028	−0.007	0.019	−0.010
Live together	0.009	−0.007	−0.077*	0.039	0.071	0.039
High education	−0.060*	−0.041	0.010	0.072*	0.071	−0.036
High household income	0.113***	0.062**	0.118***	0.113***	0.039	0.110
Effectiveness	−0.161***	0.017	−0.001	−0.107**	−0.049	0.042
Financial advantage	0.100***	0.095***	0.151***	0.148***	0.230***	0.226***
Northeast	−0.053	−0.118***	−0.047	−0.082	−0.123**	−0.014
Midwest	−0.017	−0.054	−0.017	0.020	−0.088	0.114
West	−0.108***	−0.140***	−0.047	−0.067	−0.150***	−0.034

* (**, ***) indicates that the effect is distinct from zero at the 10% (5%, 1%) significance level.