Центр экономических исследований "БЕРОК"
BEROC Economic Research Center

Climate risk perception and pro-environmental behavior: Do we fear to be better?

Yauheniya Shershunovich, 2024

BEROC Green Economy Working Paper, PP no.34

Pro-environmental behavior is crucial for protecting the environment, reducing the greenhouse gas emissions, preventing the depletion of natural resources, and mitigating climate change. This study aims to examine the drivers of pro-environmental behavior and answer the research question whether climate risk perception positively affects the behavior. It uses a nationally representative data collected in 2022 among the urban residents in Belarus aged 18-75. The study employs an instrumental variable approach to overcome endogeneity of the main explanatory variable of interest, namely climate risk perception. Additionally, the study uses propensity score matching as a robustness check of the results. The findings show that climate risk perception has a strong positive impact on pro-environmental behavior. The index of pro-environmental behavior for individuals, who start perceiving climate change as a risk, increases by 2.935 points, i.e. that they adopt one more pro-environmental activity in their life. Other relevant determinants of pro-environmental behavior among the consumers in Belarus include self-efficacy, group activities, age and income.

1. Introduction

Understanding the importance of combating climate change and achieving environmental sustainability has become a vital concern in the contemporary world since global warming and the depletion of natural resources became major global challenges. Environmental aspects are one of the most important components of the Sustainable Development Goals (SDGs) proposed by the United Nations (UN). They are prevalent in 11 out of the 17 SDGs (SDG 3 "Good health and well-being", SDG 6 "Clean water and sanitation", SDG 7 "Affordable and clean energy", SDG 8 "Decent work and economic growth", SDG 9 "Industry, innovation and infrastructure", SDG 11 "Sustainable cities and communities", SDG 12 "Responsible consumption and production", SDG 13 "Climate action", SDG 14 "Life below water", SDG 15 "Life on land", SDG 17 "Partnerships for the goals"), which shows its paramount importance to the humanity.

Human activity is one of the major contributors to climate change. There is a worldwide consensus that it is necessary to encourage pro-environmental behavior (Li et al., 2021). Reduction of negative environmental impacts caused by human activities such as pollution, deforestation, and wastage of resources may promote environment sustainability. To achieve this, people need to be motivated to behave pro-environmentally and take actions that contribute to the reduction of negative environmental impacts. These actions can include contracting energy and water consumption, recycling, using public transport, etc. According to Bin & Dowlatabadi (2005), household emissions make up around 70% of total emissions in the US. Moran et al. (2020) shows that the European Union (EU) carbon footprint can be reduced by approximately 25% through changes in consumer behavior. The findings from Shershunovich & Mirzabaev (2023) confirm that household consumption accounts for 48%–85% of the CO_2-footprints in different countries.

By adopting pro-environmental behavior, individuals can become environmental stewards and contribute to creating a sustainable future for upcoming generations. However, the question how to encourage pro-environmental behavior among consumers remains very complex. For example, people awareness of environmental problems does not necessarily translate into actual environmentally friendly behavior (Li et al., 2021). Bearing in mind the complexity of mechanism forming pro-environmental behavior, it is important to analyze the underlining factors and socio-economic premises of such behavior in order to encourage people to be more eco-conscious. The current study aims to contribute to the discussions in the scientific literature on the topic by exploring the following research question:

> **RQ**: Does climate risk perception positively affect pro-environmental behavior?

The research adds to the literature body in several aspects. Unlike many studies on behavior that use convenience samples of students, it is based on a survey data among urban residents in Belarus aged 18-75, which are representative of the total population by age, gender and region. The study focuses on Belarus that due to its geographical position represents a unique context for climate risk perception. On the one hand, the country borders with Russia where environmental concerns might not be that pronounced because of the role fossil fuels play in the economy. On the other, Belarus shares a border with the European Union (EU) where climate change is high on the agenda and people are much more aware of climate risks. Moreover, as many other developing countries, Belarus is still under-researched climate change (Schäfer and Schlichting, 2014; Blicharska et al., 2017). Building on the existing literature, the study uncovers a unique mechanism how extreme weather events and perceived environmental impact through climate risk perception can affect behavior.

The study proceeds as follows. Section 2 presents a brief overview of the factors determining pro-environmental behavior. Section 3 describes the data and methodology. Section 4 provides the results and their robustness check. Section 5 place the findings in the discussion with the existing literature. Section 6 concludes.

2. Factors determining pro-environmental behavior

Pro-active environmental behavior refers to the individual-level efforts undertaken with the aim to reduce the environmental impact of human activities. Various studies distinguish from 3 to 50 different behaviors that can be divided into broad categories, namely recycling (separation of items for recycling, avoidance of excess packaging in purchases, and etc.); reuse (reuse or reparation of goods, and etc.); energy use; conservation of water (water saving); consumption of food (purchase of locally produced food, waste less food, and etc.); nutrition (eating food which is organic, locally-grown or seasonal, avoid eating meat, and etc.); consumption of products (purchase of energy-efficient, environmental-friendly products, and goods are made from recycled materials, and etc.); transport (use of public transport, walk or cycle and etc.) (Blankenberg & Alhusen, 2019).

Pro-environmental behavior is influenced by various socio-demographic (age, education, gender), cultural, attitudinal (norms, beliefs, awareness, and values), psychological (environmental concern, perceived environmental threat, exposure to extreme weather events), and economic factors (income, economic incentives). Although, individuals of all ages have the potential to make favorable changes for the planet by adopting eco-friendly practices, some studies revealed that age is positively correlated with a care about environmental issues (Wiernik et al., 2013). Gender also determines pro-environmental behavior, and researchers have found that women are relatively more engaged in

environmentally friendly actions (Xiao & McCright, 2015). Education plays a vital role in influencing pro-environmental behavior, as it enhances people's understanding of how their choices and actions impact the environment (Mayer, 2015).

But at the same time, research shows that attitudinal and value-related factors are more significant drivers of PEB than socio-demographics characteristics (Iwinska et al., 2023). In particular, awareness and knowledge about environmental issues are important in shaping pro-environmental behavior. People who are more informed about the detrimental effects of climate change are more likely to make environmentally conscious decisions. Hence, media exposure has a potential to have a sizable impact on dissemination of environmental knowledge and cultivation of pro-environmental behavior (Awan et al., 2022). Social norms and values, as peer pressure, social approval, and desire to conform to environmental standards also have a positive effect on pro-environmental behavior and can motivate people to adopt green practices. Besides, personal beliefs and attitudes towards the environment are key factors affecting pro-environmental behavior (Miller et al., 2022). People who hold strong environmental values and beliefs are more likely to engage in eco-friendly practices.

Pro-environmental behavior can be triggered by such physiological factors as exposure to extreme weather events and perceived environmental threat. Individuals who have experienced the devastating effects of natural disasters such as hurricanes, floods, and wildfires are often more likely to take action to prevent further environmental degradation. This heightened concern for the environment can lead to changes in behavior, including reducing energy consumption, recycling, and using public transportation. Additionally, experiencing extreme weather events can increase awareness and concern about climate change, leading to more advocacy for policies aimed at mitigating the effects of climate change. As such, exposure to extreme weather events can be a catalyst for pro-environmental behavior and can increase individuals' willingness to take action to protect the environment.

The interaction between perceived environmental impact or threat and pro-environmental behavior is complex and multifaceted. Individuals' perceptions of the environmental impact of their actions can influence their willingness to engage in pro-environmental behavior. Research also showed that perceptions of ecological threat can result in higher engagement in pro-environmental behavior (Schmitt et al., 2018).

Similarly, engaging in pro-environmental behavior can lead to increased awareness of people's environmental impact. When individuals start recycling and become more conscious of the amount of waste produced, they may become more sensitive to their impact on surroundings, and as a result, it can be a cause of adopting other environmentally friendly practices. However, the relationship between perceived environmental impact and pro-environmental behavior can also be complicated. For example, some people may underestimate the impact of their actions and not engage in behavior they believe will

have significant consequences. Additionally, even when individuals recognize their actions' environmental impact, they may not always engage in pro-environmental behaviors due to factors such as inertia, convenience, and habituation.

The interaction between economic factors and pro-environmental behavior is a dynamic and non-linear relationship influenced by various factors such as, for example, government policy. In theory, financial security may play a role in promoting sustainability, and therefore, higher income should be positively linked to a greater likelihood of engaging in pro-environmental behavior. However, there is no clear evidence about positive connection between income and pro-environmental behavior. Studies revealed that household income either has no effect on pro-environmental behavior (Whitmarsh & O'Neill, 2010), or it is correlated with lower individual pro-environmental behavior (Longhi, 2013). On the contrary, poorer people undertake more eco-friendly actions (Longhi., 2013).

There is a relationship between economic incentives and disincentives and pro-environmental behaviors. Governments can encourage it by providing financial incentives to individuals that adopt green practices. Accessibility to green technologies and products would influence pro-environmental behavior, as well as availability and affordability of sustainable technologies and products, which may encourage individuals to adopt environmentally friendly practices.

3. Data and Methodology

3.1 Empirical model

In our study we aim to investigate whether climate change risk perception can influence pro-environmental behavior of individuals. To do that, we estimate the following structural equation model:

$$beh_i = \beta_0 + \beta_1 clim\_risk_i + \sum \beta_2\, media_i + \sum \beta_3 beliefs_i + \sum \beta_4 group\_act + \sum \beta_5 dem\_char_i + u_i \quad (1)$$

The outcome variable beh_i represents a sum of indicators denoting frequency of performing different pro-environmental actions (table 1). Most studies research pro-environmental actions separately (e.g., "using e-vehicles" in Shamungavel & Balakrishnan, 2023; He et al., 2018; "household recycling" in Corrado et al., 2022; Bucciol et al., 2019; Varotto & Spagnolli, 2017; "energy saving in households" in Li et al., 2021; Liao et al., 2020; Pothitou et al., 2016; "water use for household activities" in Attari, 2014). Unlike them, we follow the approach of Zeng et al. (2020) and analyze the sum of scores on different pro-active environmental behaviors. The main variable of interest is $clim\_risk_i$. It is a binary variable describing whether a person thinks that climate change is a threat to the people in the country in

the next 20 years. However, climate change risk perception is likely to be influenced by other observed and unobserved factors. This means that $clim\_risk_i$ might be correlated with the error term u_i, which can result in endogeneity bias in the estimation of β_1. To reduce this bias, we use an instrumental variable (IV) approach. This approach requires an instrumental variable which is correlated with the endogenous variable $clim\_risk_i$, has no direct effect on the outcome variable beh_i and is uncorrelated with the error term u_i (Wooldridge, 2010). The estimation is performed via two-stage-least-squares (2SLS) in which $clim\_risk_i$ is instrumented through exposure to extreme weather events $weather_i$ and perceived environmental impact en_impact_i (table 1). Our instruments build on the fact that personal experience of extreme weather events, natural disasters and other environmental problems is positively associated with climate change risk perceptions. That is confirmed by considerable research literature (e.g., Zaalberg et al., 2009; Akerlof et al., 2012; Wachinger et al., 2013; Carlton et al., 2015; Dai et al., 2015; Lujala et al., 2015; Demski et al., 2017; Frondel et al., 2017; Hamilton-Webb et al., 2017).

In our regression model we control for variables which can jointly influence climate change risk perception and pro-environmental behavior. They include media variables ($\sum \beta_2 media_i$), such as exposure to climate change information on TV, on the radio, on newspapers, and on the Internet; psychological factors ($\sum \beta_3 beliefs_i$), such as environmental self-efficacy and beliefs; environmental group activities ($\sum \beta_4 group\_act_i$) including discussion of information about environmental problems or sustainable lifestyles, participation in activities organized by environmental groups to mitigate environmental problems, and demographic characteristics of individuals ($\sum \beta_m dem\_char_i$), such as age, gender, income, education, number of people in the household, region of living (table 1). Table 1 represents construction and definition of variables used in the model.

Table 1

Construction and definition of variables

Variable	Description
Dependent variable	
Behavioral index	The index is calculated as a sum of indicators denoting frequency (1-never; 4-always) of performing the following pro-environmental activities: (1) sorting glass or plastic or paper for recycling; (2) walking, biking or using public transportation instead of a car; (3) buying food products grown/produced locally; (4) reducing the use of plastic bags, or using your own bag when shopping; (5) choosing to reuse or repair something (e.g., clothes) rather than throw it away; (6) buying second-hand; (7) reducing the energy or fuel used at home; (8) choosing to save or reuse water; (9) eating less meat and more vegetables.
Endogenous variable	
Climate risk perception	A dummy variable equal to 1 if a person thinks that climate change is a threat to the people in the country in the next 20 years, and 0 otherwise
Instruments	
Exposure to extreme weather events	A dummy variable equal to 1 if a person or someone who they personally know experienced serious harm from severe weather events, such as floods or violent storms, in the past two years, and 0 otherwise;
Perceived environmental impact	A variable estimated on a 5-point Likert scale (1-don't agree at all; 5-completely agree) whether an individual agrees that environmental problems have a direct effect on their everyday life.
Independent variables	
Climate TV	A variable estimated on a 4-point Likert scale (0-don't use this type of media; 1-never; 4-very often) to denote the frequency of coming across the information about climate change, environmental problems or sustainable lifestyle on TV;
Climate radio	A variable estimated on a 4-point Likert scale (0-don't use this type of media; 1-never; 4-very often) to denote the frequency of coming across the information about climate change, environmental problems or sustainable lifestyle on the radio;
Climate newspapers	A variable estimated on a 4-point Likert scale (0-don't use this type of media; 1-never; 4-very often) to denote the frequency of coming across the information about climate change, environmental problems or sustainable lifestyle on the newspapers;

Climate Internet	A variable estimated on a 4-point Likert scale (0-don't use this type of media; 1-never; 4-very often) to denote the frequency of coming across the information about climate change, environmental problems or sustainable lifestyle on the Internet;
Self-efficacy 1	A variable estimated on a 5-point Likert scale (1-don't agree at all; 5-completely agree) to evaluate whether an individual believes that they have the ability to take action to help the environment;
Self-efficacy 2	A variable estimated on a 5-point Likert scale (1-don't agree at all; 5-completely agree) to evaluate whether an individual agrees that they can still change behavior to be more environmentally-friendly, even when it costs more money or takes more time;
Environmental beliefs 1	A variable estimated on a 5-point Likert scale (1-don't agree at all; 5-completely agree) to evaluate whether an individual agrees that human ingenuity will ensure that we make the earth livable;
Environmental beliefs 2	A variable estimated on a 5-point Likert scale (1-don't agree at all; 5-completely agree) to evaluate whether an individual agrees that the earth has plenty of natural resources if we just learn how to develop them;
Group activities 1	A variable estimated on a 4-point Likert scale (1-never; 4-always) to denote the frequency with which individuals discuss information about environmental problems or sustainable lifestyle with others;
Group activities 2	A variable estimated on a 4-point Likert scale (1-never; 4-always) to denote the frequency with which individuals participate in activities organized by environmental groups (organizations) to mitigate environmental problems;
Age	A number of years of a person's age
Gender	A dummy variable equal to 1 if a person is a female and to 0 if a person is a male
Income	A variable describing the total income of a respondent's family on average per month in Belarusian rubles: (1) up to 450 BYR (2) 451-900 BYR (3) 901-1350 BYR (4) 1351-1800 BYR (5) 1801-2250 BYR (6) 2251-2700 BYR (7) 2701-5700 BYR (8) 5701 and more
Education	A variable describing the highest achieved level of education: (1) Basic education (up to 8/9 years of schooling)

	(2) Secondary education (up to 10/15 years of schooling) (3) Vocational and technical education (4) Secondary specialized education (5) Incomplete higher education (6) Higher/tertiary education
Household	The total number of people in your household
Region	A variable describing the region of living: (1)- Brest region (2) - Vitebsk region (3) - Gomel region (4) - Grodno region (5) – Minsk (6) - Minsk region (7) - Mogilev region

3.2 Study area

Belarus is a landlocked country located on the East European lowland. In the northeast and east it borders with the Russian Federation, in the southeast and south with Ukraine. On its northwestern and western sides, it is bordered by the three European Union (EU) states, that is Latvia, Lithuania, and Poland. The country has around 20,800 rivers flowing through its territory with their total length of 90,600 km. Around 40.1% of the country's total area is covered by forests (Official Internet Portal of the President of the Republic of Belarus, 2024). Belarus has a moderately continental climate with warm summers and cool humid winters. The average summer temperature in the country is + 18 ºC (Belhydromet, 2024), while the average temperature in winter ranges from - 4.5 ºC to - 8 ºC (World Bank Group, 2020). According to the hydrometeorological observations, the average annual temperature for 1989-2019 exceeded the climatic norm in Belarus by 1.3 ºC (UNDP, 2020). In some years the daily temperature in summer reaches up to + 35 ºC, which is a dangerous hydrometeorological phenomenon (Belhydromet, 2024). The World Bank Group (2020) estimations show that atmospheric hazards such as wind, localized rain, hail, and extreme temperatures result in losses of around 0.4% of GDP on an annual basis. Moreover, flooding affects about 100,000 people in Belarus on average and causes losses of around 1% of GDP every year (World Bank Group, 2020). Although extreme weather events happened also earlier, in recent years they have occurred more frequently and become more intensive due to climate change (Tochitskaya, 2020).

Climate change risk perception varies across countries. Using the Lloyd's Register Foundation (2023) World Risk Poll collected in 2019, Le Coq and Paltseva (2021) analyzed climate change concerns across countries in Eastern and Western Europe. Their analysis reveals that on average people in the non-EU part of Eastern Europe are less concerned about climate change than the population in the EU-part of Eastern Europe and in Western Europe

(Le Coq & Paltseva, 2021). The climate change risk perception among the population of Belarus is close to the region average.

Fig. 1 represents the percentage of the population in Belarus who consider climate change as a threat to the country in 2010, 2019 and 2022. The survey data for the years presented at fig.1 were collected by different organizations. Due to that, the samples are not identical, and it is difficult to make a direct comparison. Nevertheless, one can still observe that in recent years the population in Belarus has become more aware of climate change problems.

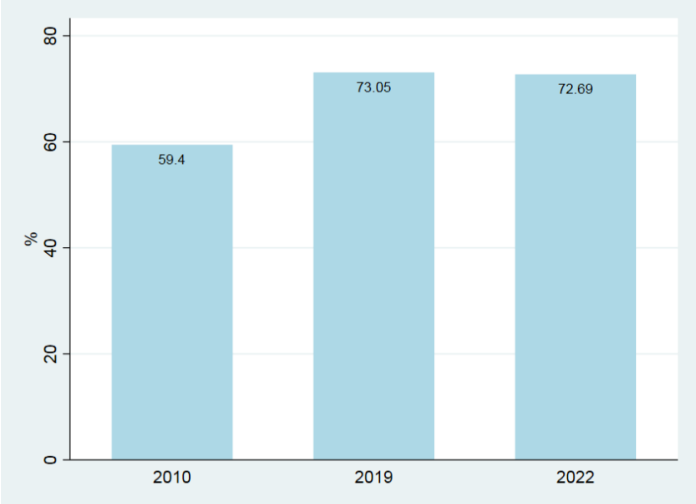

Fig. 1. Percentage of people in Belarus who consider climate change to be a threat to the country

Source: Shershunovich (2023).

3.3 Data

The study uses the data of the online survey conducted in April 2022 among the urban population in Belarus aged 18-75. The aim of the survey was to collect individual data on environmentally responsible behaviors and climate change perceptions. The respondents were recruited through an online panel comprising around 25,000 participants by the marketing research company "MIA Research". The sample includes 1029 individuals and is representative by age, gender, and region to the whole population. According to the results, 72.7% of the respondents consider climate change as a threat to the country in the next 20 years. In the sample, 48.59% of the respondents are men and 51.41% are women. The average age is 41.03 years. 26.92% of the respondents live in Minsk, the capital city, 14.77% – in Brest region, 12.24% – in Vitebsk region, 14.67% – in Gomel region, 10.01% – in Grodno region, 11.37% – in Minsk region, and 10.01% – in Mogilev region.

3.4 Descriptive statistics

Table 2 compares the mean values of the different characteristics between individuals who consider climate change as a risk and those who don't. The summary statistics of all variables used in the study are presented in table A1 in the Appendix. As we can see from table 2, individuals who consider climate change as a risk have a higher behavioral index. This means that they are engaged in pro-environmental actions more often than people who don't see climate change as a threat.

Table 2

Characteristics of individuals who consider climate change as a risk vs. those who don't

Characteristics	Observations	Climate change is a risk		Climate change is not a risk	
		Mean	Std. Err.	Mean	Std. Err.
Behavioral index	1029	24.219	0.151	22.911	0.253
Climate TV	1029	1.832	0.045	1.680	0.074
Climate radio	1029	1.186	0.039	1.053	0.063
Climate newspapers	1029	1.007	0.039	0.794	0.060
Climate Internet	1029	2.782	0.032	2.530	0.058

Self-efficacy 1	1029	3.659	0.028	3.221	0.057
Self-efficacy 2	1029	3.610	0.030	3.089	0.057
Environmental beliefs 1	1029	3.595	0.033	3.726	0.052
Environmental beliefs 2	1029	3.743	0.037	3.904	0.053
Group activities 1	1029	2.126	0.024	1.879	0.038
Group activities 2	1029	1.583	0.025	1.395	0.041
Age	1029	40.876	0.482	41.452	0.791
Gender	1029	0.533	0.018	0.463	0.030
Income	1029	3.648	0.060	3.698	0.102
Education	1029	4.864	0.052	4.801	0.089
Household	1029	2.929	0.045	2.807	0.074

Besides, individuals who believe in climate change are more often exposed to information about it and other environmental problems on all the media (TV, radio, newspapers, the Internet) included in the analysis. It is worth noting that in both groups of individuals the Internet is the leading platform through which they are exposed to information related to environmental problems and climate change. Regarding self-efficacy, individuals concerned about climate change have a stronger belief in their own ability to help the environment than those who are not. The environmental beliefs used in this study demonstrate the anti-environmental or pro-materialistic orientation of individuals, in accordance with our expectations they are stronger in people who do not show concern about climate change. There are no substantial differences in socio-demographic characteristics between both groups of individuals. The mean age in both groups is 41 years old, the household's income is in the range 1351-1800 BYR, the average size of a family is 3 people. For both groups the average education level is incomplete higher education. The only peculiar thing in socio-demographic characteristics is that among individuals who consider climate change as a risk the majority (53.34%) are women. Among individuals who do not believe in climate change the majority are men (53.74%).

Fig. 2 shows frequences of different pro-environmental actions used to calculate the behavioral index. 28-29% of the respondents *always* save energy, water, and choose to reuse or repair things instead of throwing them away. Economic factors can explain to some extent the 'popularity' of these actions among the population. Rising energy and water tariffs and numerous repair facilities in close proximity to residential areas create favorable conditions for engagement in these pro-environmental behaviors. The least performed actions include decreasing meat consumption and buying second-hand. 68.7% and 74% of the participants respectively *never* or *seldom* (*sometimes*) perform these actions. That

might largely be explained by geographical and cultural factors. Due to the seasonal availability of fresh vegetables and the lack of access to the sea, Belarusian cuisine has traditionally been heavily based on meat products. Moreover, the culture of eating vegan or vegetarian is only at its nascent phase in the country. As regards buying second-hand, the tradition of flea markets at which people can buy second-hand goods in relatively good conditions, which is widespread in some countries of Western Europe (e.g., Germany, France), is absent in Belarus. Moreover, buying second-hand has a negative association of being poor or having a lower social status in the minds of Belarusian people. That restricts them from performing this pro-environmental action more often.

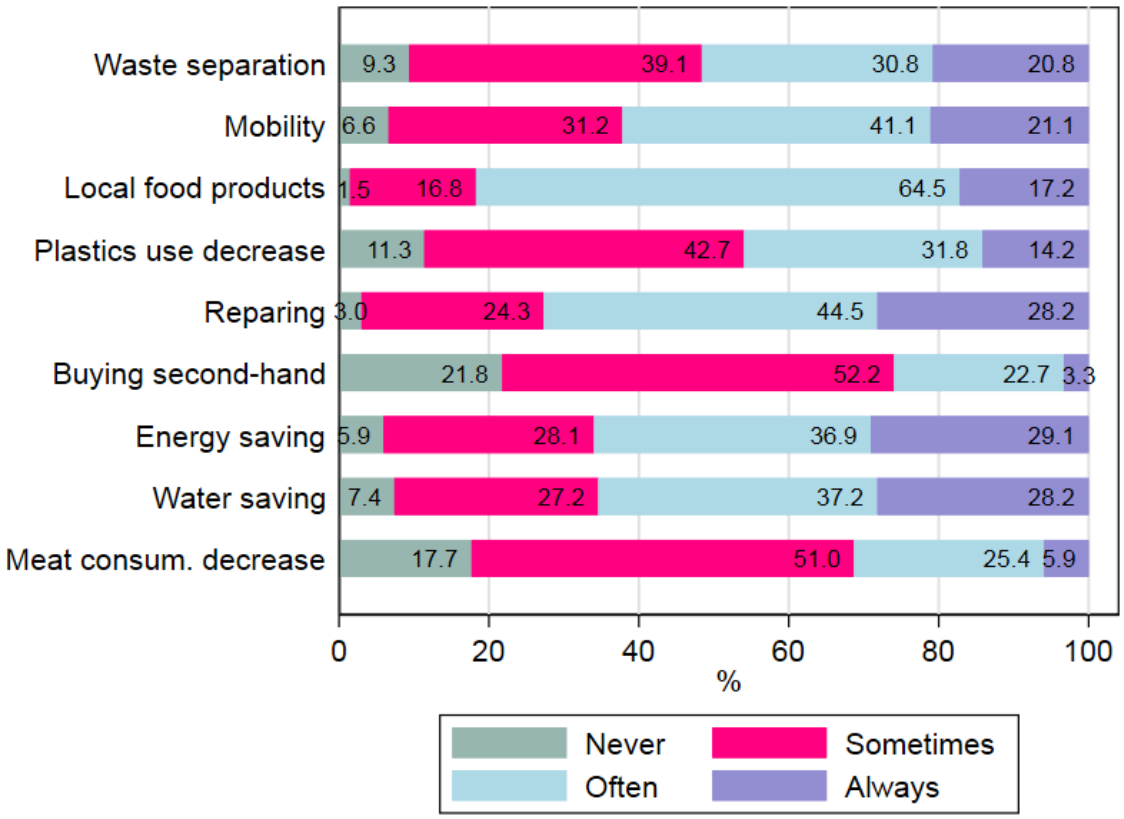

Fig. 2. Frequences of pro-environmental actions performed by people in Belarus

Source: authors' own construction based on the collected survey data.

4. Results

4.1 Instrumental variable approach

Table 3 presents the results of the 2SLS estimation and the OLS results for comparative purposes. In the 2SLS first stage we get predicted values for climate risk perception and use them in the 2SLS second stage to correct for the

endogeneity. The results of the 2SLS estimation show that climate risk perception is a significant predictor of pro-environmental behavior, unlike the OLS results. When individuals start perceiving climate change as a risk, their behavioral index increases by 2.935 points, i.e. that they adopt one more pro-environmental activity in their life[1]. These results are statistically significant at a 5% level.

Table 3

Comparison of the OLS and 2SLS estimation results

	OLS	2SLS – first stage	2SLS – second stage
Variables	Behavioral index	Climate risk perception	Behavioral index
Climate risk perception	0.388		2.935**
	(0.270)		(1.294)
Climate TV	0.140	-0.008	0.148
	(0.118)	(0.013)	(0.123)
Climate newspapers	-0.031	0.014	-0.083
	(0.144)	(0.016)	(0.151)
Climate Internet	0.134	0.029*	0.062
	(0.145)	(0.016)	(0.154)
Climate radio	-0.164	0.001	-0.157
	(0.136)	(0.015)	(0.141)
Self-efficacy 1	0.760***	0.040**	0.599***
	(0.168)	(0.020)	(0.192)
Self-efficacy 2	0.081	0.063***	-0.119
	(0.159)	(0.018)	(0.192)
Environmental belief 1	0.112	-0.038**	0.212
	(0.138)	(0.016)	(0.151)
Environmental belief 2	0.105	-0.025*	0.175
	(0.124)	(0.014)	(0.133)
Group activities 1	1.415***	0.022	1.327***
	(0.214)	(0.024)	(0.226)
Group activities 2	1.082***	-0.001	1.045***
	(0.194)	(0.022)	(0.202)
Age	0.068***	-0.001	0.070***
	(0.010)	(0.001)	(0.010)
Gender	0.248	0.019	0.198
	(0.237)	(0.027)	(0.246)
Income	-0.160**	-0.004	-0.147*
	(0.074)	(0.008)	(0.076)
Education	0.090	-0.003	0.090
	(0.086)	(0.010)	(0.088)
Household	0.068	0.005	0.046
	(0.099)	(0.011)	(0.102)
Region	0.089	-0.004	0.102
	(0.061)	(0.007)	(0.063)
Exposure to extreme weather events		0.150***	
		(0.035)	

[1] Each pro-environmental action is measured on a 4-point Likert scale (1 – never; 4 – always). The behavioral index is the sum of scores on different pro-active environmental behaviors. Thus, an increase of the behavioral index by 2.935 points means that an individual engages in a new pro-environmental behavior to the level of "often".

Perceived environmental impact		0.080*** (0.016)	
Constant	11.505*** (1.023)	0.256** (0.117)	10.666*** (1.137)
Number of observations	1026	1026	1026

Note: Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Other statistically significant predictors of pro-environmental behavior include self-efficacy 1, group activities 1 and 2, age and income. Among these factors pro-environmental actions performed with other people (group activities) exert the largest effect on the behavioral index. With respect to self-efficacy, only self-efficacy 1 ('an individual belief that they have the ability to take action to help the environment') is a statistically significant predictor of pro-environmental behavior. However, both self-efficacies 1 and 2 positively affect climate change risk perception. These results are statistically significant at a 5% and 1% level respectively. From the socio-economic characteristics, only age and income exert some influence on the behavioral index. It is interesting to note that the higher the income of an individual is, the less prone they are to engage in pro-environmental behavior. It is worth noting that exposure to the information on different media about climate change, environmental problems or sustainable lifestyle does not make an influence on engagement in pro-environmental activities. However, exposure to this information on the Internet is a positive predictor of climate risk perceptions. The situation is similar with environmental beliefs 1 and 2. The beliefs that show anti-environment orientation of individuals ('human ingenuity will ensure that we make the earth livable'; 'the earth has plenty of natural resources if we just learn how to develop them') do not exert any statistically significant influence on the behavioral index. At the same time, they are negatively associated with climate risk perceptions. Thus, we can conclude that there are different mechanisms at play for pro-environmental behavior and climate risk perceptions.

Based on the 2SLS first stage results, it can be inferred that exposure to extreme weather events and perceived environmental impact are good instruments for climate change risk perception. Additionally, we conduct the tests to check whether the instruments are uncorrelated with the error process, relevant and strong (table A2 in the Annex). The Sargan test of overidentification checks whether the instruments are appropriately independent of the error process. The null hypothesis for this test is that all instruments are uncorrelated with the error term u_i. According to the results (table A2 in the Annex), we accept the null hypothesis and conclude that the instruments are valid. The underidentification test checks whether the instruments are relevant. The null hypothesis for this test says that the instruments are underidentified. In accordance with the results, we reject underidentification. As the F statistic in the weak identification test is higher than 10 (F statistic = 24.643), we can conclude that the instruments are strong.

4.2 Robustness check: propensity score matching

To see whether our results still hold when a different methodology is used, we apply propensity score matching as a robustness check. Propensity score matching as well as an instrumental variable approach belongs to quasi-experimental methods. It recreates the conditions of a natural experiment when non-experimental data are used (Blundell & Costa Dias, 2000). Propensity score matching rests on the assumption that assignment to treatment is random conditional on some observed characteristics. By matching each treated observation with a non-treated one of similar characteristics, this method allows us to construct an artificial control group and then measure the average treatment effect on the treated.

In our case the treatment variable is climate risk perception, which is 1 for the treated observations and 0 – for the untreated ones. In the first step, we estimate a probit model to calculate the probability of receiving the treatment (a propensity score) based on some observed characteristics x that may affect the likelihood of being assigned to the treated group:

$$p(x) = prob(D=1|x)=E(D|x) \quad (2)$$

where D is the dependent variable and x are independent variables.

As we already know from the first stages results of our 2SLS estimation which variables are likely to affect the climate risk perception, we use them in our probit regression estimation (table 4).

Table 4

Probit regression results for the propensity score matching estimation

Variables	Climate risk perception
Climate Internet	0.097*
	(0.050)
Self-efficacy 1	0.126*
	(0.065)
Self-efficacy 2	0.207***
	(0.061)
Environmental belief 1	-0.157***
	(0.052)
Exposure to extreme weather events	0.686***
	(0.139)

Perceived environmental impact	0.256***
	(0.052)
Constant	-1.152***
	(0.281)
Number of observations	1029

Note: Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1
The common support option has been selected. The region of common support is (0.117, 0.987).

The balancing condition assures that assignment to treatment is independent of the *x* characteristics, given the same propensity score. It means that if we have the same propensity score, the *x* characteristics will also be similar. The balancing property is satisfied in our model[2].

In the second step, each treatment observation is matched with one or more control observations on the propensity scores using different matching techniques (nearest neighbor matching, radius matching, kernel matching, stratification method). Then, the outcome *y* (behavioral index) is compared between the treated and control observations after matching. In this way, the average treatment effect on the treated is calculated:

$$ATET=E(\Delta|p(x), D=1)=E(y_1|p(x), D=1)-E(y_0|p(x),D=0) \quad (3)$$

Table presents the ATET based on different matching techniques. We can conclude that except for the nearest neighbor matching, there is a statistically significant difference in pro-environmental behavior between individuals who consider climate change to be a risk and those who don't. However, the size of the effect is smaller than in the case of using the instrumental variable approach.

Table 5

Propensity score matching results

Matching method	Average treatment effect on the treated
Nearest Neighbor Matching	-0.222
	(0.499)
Radius matching method	0.873***
	(0.333)
Kernel matching method	0.620*
	(0.364)
Stratification method	0.611*
	(0.369)

Note: Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

5. Discussion

[2] We had to leave environmental belief 2 out of the model for the balancing property to be satisfied.

In the theory of planned behavior (Ajzen, 1991), risk perception is considered to be a major predictor of engaging in behavior change. Our findings show that climate risk perception positively and directly affects pro-environmental behavior among the consumers in Belarus. The mechanism for that is as follows. When people have personal experience of extreme weather events or other environmental impacts or know someone personally who has, they are more concerned about climate change. And these concerns make them act more environmentally friendly in their lives. Bradley et al. (2020) analyze the effect of climate risk perception, response efficacy and psychological adaptation on pro-environmental behavior in Australian and French samples. In their model, climate risk perception is a strong indirect predictor of pro-environmental behavior as it influences the behavior thorough response efficacy and psychological adaptation. However, they conclude that major predictors of the behavior differ between nations. In the study of pro-environmental behavior among Canadian citizens, climate risk perception proves to be a statistically significant direct predictor of such pro-environmental actions as environmental tax support and social advocacy (Smith et al., 2021). In a Chinese study among hospital workers (Shen et al., 2024), climate change health risk perception shapes pro-environmental intention and through it positively influences pro-environmental behavior.

After climate risk perception, group activities such as engagement in discussions of information about environmental problems or sustainable lifestyle with others and participation in activities organized by environmental groups to mitigate environmental problems exert the largest effect on pro-environmental behavior in Belarus. These findings are in line with the ideas from *Narrative Economics* by Shiller (2020). According to Shiller (2020), people form information into stories and these stories accompanying social interactions among people can influence economic behavior. Hori et al. (2013) find that social interaction has a strong positive effect on energy-saving behavior in five major Asian cities.

In the study of Hori et al. (2013), age and income are weak positive determinants of pro-environmental behavior. In our study, age exerts a small positive effect on the behavior, but income is negatively associated with it. Region and income are found to be important determinants of pro-environmental behavior (Ifegbesan & Rampedi, 2018).

It is important to note that exposure to information about climate change on different media does not have a direct effect on pro-environmental behavior. Nevertheless, it is still important (at least, on the Internet) for the formation of climate risk perception. These findings are in accordance with the results from the structural equation model (SEM) from Shershunovich (2023) in which exposure to climate change information on different media does not directly affect pro-environmental behavior but exerts a strong indirect effect on it. It is worth drawing attention to the fact that there are different

mechanisms which are active in forming climate risk perception and pro-environmental behavior. For climate risk perception, exposure to extreme weather events as well as perceived environmental impact are the determinant factors. Besides, environmental beliefs and exposure to climate change information on the Internet are also important. For pro-environmental behavior, climate risk perception and group activities are the most significant determinants. Additionally, age and income also play a role in forming behavior. And only self-efficacy is active in both climate risk perception and behavior.

6. Conclusion

Pro-environmental behavior is crucial for protecting the environment, reducing the greenhouse gas emissions, preventing the depletion of natural resources, and mitigating climate change. This study aims to examine the drivers of pro-environmental behavior and answer the research question whether climate risk perception positively affects the behavior. It uses a nationally representative data collected in 2022 among the urban residents in Belarus aged 18-75. The study employs an instrumental variable approach as a means to overcome endogeneity of the main explanatory variable of interest, namely climate risk perception. Exposure to extreme weather events and perceived environmental impact function as instruments. Other control variables of the model include exposure to climate change information on TV, radio, newspapers, and on the Internet; such psychological factors as environmental self-efficacy and beliefs; group activities such as discussion of environmental information with others, participation in events organized by environmental groups to help mitigate environmental problems; and socio-demographic characteristics (age, gender, income, education, number of people in the household, region of living). Additionally, the study uses propensity score matching as a robustness check of the results.

The findings show that climate risk perception has a strong positive impact on pro-environmental behavior. The index of pro-environmental behavior for individuals, who start perceiving climate change as a risk, increases by 2.935 points, i.e. that they adopt one more pro-environmental activity in their life. Other relevant determinants of pro-environmental behavior among the consumers in Belarus include self-efficacy, group activities, age and income. Among these factors, group environmental activities have the largest effect on engagement in individual pro-environmental actions. At the same time, the results show that neither such socio-demographic factors as gender, education, number of people in the household, region of living, nor such media variables as exposure to climate change information on different media exert a direct impact on pro-environmental behavior in Belarus. However, the results suggest that exposure to environmental information on the Internet plays an important role in forming climate risk perception.

The findings underline the necessity of increasing awareness about climate change risks and promoting a sustainable lifestyle among the Belarusian population. The role of mass media in delivering the message on climate change should be increased. Additionally, environmental actions performed in groups could be integrated at all the levels of education and promoted through environmental organization in order to teach people to care about the environment also when they are alone.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179–211. https://doi.org/10.1016/ 0749-5978(91)90020-T

Akerlof, K., Maibach, E. W., Fitzgerald, D., Cedeno, A. Y., & Neuman, A. (2013). Do people "personally experience" global warming, and if so how, and does it matter? *Global Environmental Change, 23*, 81-91. https://doi.org/10.1016/j.gloenvcha.2012.07.006

Attari, S. Z. (2014). Perceptions of water use. *Proceedings of the National Academy of Sciences*, *111*(14), 5129-5134.

Awan T. M., et.al. (2022). Does media usage affect pro-environmental attitudes and behaviors? Evidence from China. *International Review of Economics & Finance, Vol. 82, November 2022,* 307-317.

Belhydromet (2024). Retrieved 17 May, 2024 from https://belgidromet.by/ru/news-ru/view/kakim-byvaet-leto-v-belarusi-7033/

Bin, S., & Dowlatabadi, H. (2005). Consumer lifestyle approach to US energy use and the related CO2 emissions. *Energy policy*, *33*(2), 197-208.

Blankenberg A-K., Alhusen H. (2019). On the Determinants of Pro-Environmental Behavior: A Literature Review and Guide for the Empirical Economist. *CEGE Discussion Paper. May 2018, No 350, Revised Version October 2019*.

Blicharska, M., Smithers, R. J., Kuchler, M., Agrawal, G. K., Gutiérrez, J. M., Hassanali, A., ... & Mikusiński, G. (2017). Steps to overcome the North–South divide in research relevant to climate change policy and practice. *Nature Climate Change, 7(1),* 21-27.

Blundell, R., & Costa Dias, M. (2000). Evaluation methods for non-experimental data. *Fiscal studies*, *21*(4), 427-468.

Bradley, G. L., Babutsidze, Z., Chai, A., & Reser, J. P. (2020). The role of climate change risk perception, response efficacy, and psychological adaptation in pro-environmental behavior: A two nation study. *Journal of Environmental Psychology*, *68*, 101410.

Bucciol, A., Montinari, N., & Piovesan, M. (2019). It wasn't me! Visibility and free riding in waste disposal. *Ecological Economics*, *157*, 394-401.

Carlton, J. S., Mase, A. S., Knutson, C. L., Lemos, M. C., Haigh, T., Todey, D. P. & Prokopy, L. S. (2016). The effects of extreme drought on climate change beliefs, risk perceptions, and adaptation attitudes. *Climatic Change, 135*, 211-226. https://doi.org/10.1007/s10584-015-1561-5

Corrado, L., Fazio, A., & Pelloni, A. (2022). Pro-environmental attitudes, local environmental conditions and recycling behavior. *Journal of Cleaner Production*, *362*, 132399.

Dai, J., Kesternich, M., Цschel, A., Ziegler, A. (2015). Extreme weather experiences and climate change beliefs in China: aneconometric analysis. *Ecol. Econ. 116*, 310–321.

Demski, C., Capstick, S., Pidgeon, N., Sposato, R. G., & Spence, A. (2017). Experience of extreme weather affects climate change mitigation and adaptation responses. *Climatic Change, 140*, 149-164. https://doi.org/10.1007/s10584-016-1837-4

Frondel, M., Simora, M., & Sommer, S. (2017). Risk perception of climate change: Empirical evidence from Germany. *Ecological Economics, 137,* 173-183. https://doi.org/10.1016/j.ecolecon.2017.02.019

Hamilton-Webb, A., Naylor, R., Manning, L., & Conway, J. (2017). The relationship between risk experience and risk response: A study of farmers and climate

change. *Journal of Risk Research*. https://doi.org/10.1080/13669877.2016.1153506

He, X., Zhan, W., & Hu, Y. (2018). Consumer purchase intention of electric vehicles in China: The roles of perception and personality. *Journal of Cleaner Production*, *204*, 1060-1069.

Hori, S., Kondo, K., Nogata, D., & Ben, H. (2013). The determinants of household energy-saving behavior: Survey and comparison in five major Asian cities. *Energy Policy*, *52*, 354-362.

Ifegbesan, A. P., & Rampedi, I. T. (2018). Understanding the role of socio-demographic and geographical location on pro-environmental behavior in Nigeria. *Applied Environmental Education & Communication*, *17*(4), 335-351.

Iwinska K. et. al. (2023). The Primary Drivers of Private-Sphere Pro-Environmental Behaviour in Five European Countries During the Covid-19 Pandemic. *Journal of Cleaner Production, Volume 393, 20 March 2023*, 136330.

Le Coq, C., & Paltseva, E. (2021). Green Concerns and Salience of Environmental Issues in Eastern Europe. *FREE Network Policy Brief*. https://freepolicybriefs.org/wpcontent/uploads/2021/06/freepolicybriefs20210607.pdf.

Li, X., Zhang, D., Zhang, T., Ji, Q., & Lucey, B. (2021). Awareness, energy consumption and pro-environmental choices of Chinese households. *Journal of Cleaner Production*, *279*, 123734. https://doi.org/10.1016/j.jclepro.2020.123734

Liao, X., Shen, S. V., & Shi, X. (2020). The effects of behavioral intention on the choice to purchase energy-saving appliances in China: the role of environmental attitude, concern, and perceived psychological benefits in shaping intention. *Energy Efficiency*, *13*(1), 33-49.

Longhi, S. (2013). Individual pro-environmental behaviour in the household context. *ISER Working Paper Series 2013-21, Institute for Social and Economic Research.*

Lloyd's Register Foundation (2023). World Risk Poll 2019. https://wrp.lrfoundation.org.uk/.

Lujala, P., Lein, H., & Rød, J. K. (2015). Climate change, natural hazards, and risk perception: The role of proximity and personal experience. *Local Environment, 20,* 489-509. https://doi.org/10.1080/13549839.2014.887666

Mayer A. (2015). Does Education Increase Pro-Environmental Behavior? Evidence from Europe. *Ecological Economics. Vol. 116, August 2015*, 108-121.

Miller L. B., et.al. (2022). Relationships Among Environmental Attitudes, Environmental Efficacy, and Pro-Environmental Behaviors Across and Within 11 Countries. *Environment and Behavior, 54(7–8),* 1063–1096.

Moran, D., Wood, R., Hertwich, E., Mattson, K., Rodriguez, J. F., Schanes, K., & Barrett, J. (2020). Quantifying the potential for consumer-oriented policy to reduce European and foreign carbon emissions. *Climate Policy*, *20*(sup1), pp. 28-38.

Official Internet Portal of the President of the Republic of Belarus (2024). Retrieved May 17, 2024 from https://president.gov.by/en/belarus

Pothitou, M., Hanna, R. F., & Chalvatzis, K. J. (2016). Environmental knowledge, pro-environmental behaviour and energy savings in households: An empirical study. *Applied Energy*, *184*, 1217-1229.

Schäfer, M. S., & Schlichting, I. (2014). Media representations of climate change: A meta-analysis of the research field. *Environmental communication, 8(2),* 142-160.

Schmitt M. T., et. al. (2018). Unpacking the Relationships Between Pro-environmental Behavior, Life Satisfaction, and Perceived Ecological Threat. *Ecological Economics, 143(5870,* 130-140.

Shanmugavel, N., & Balakrishnan, J. (2023). Influence of pro-environmental behaviour towards behavioural intention of electric vehicles. *Technological Forecasting and Social Change*, *187*, 122206.

Shen, T., Rasdi, I. B., Ezani, N. E. B., & San, O. T. (2024). The mediating role of pro-environmental attitude and intention on the translation from climate change health risk perception to pro-environmental behavior. *Scientific reports*, *14*(1), 9831.

Shershunovich, Y., & Mirzabaev, A. (2023). Social cost of household emissions: cross-country comparison across the economic development spectrum. *Environment, Development and Sustainability*, *26*(6), 15285-15305. https://doi.org/10.1007/s10668-023-03248-3

Shershunovich, Y. (2023). *Economics of consumer and business behavior related to environment* (Doctoral dissertation, Universitäts-und Landesbibliothek Bonn).

Shiller, R. J. (2020). *Narrative economics: How stories go viral and drive major economic events*. Princeton University Press.

Smith, C. J., Dupré, K. E., McEvoy, A., & Kenny, S. (2021). Community perceptions and pro-environmental behavior: The mediating roles of social norms and climate change risk. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement*, *53*(2), 200.

Tochitskaya, I. (2020). Exposure of Financial Sector to Climate-Related Risks: Assessments of Central Banks. *BEROC Green Economy Policy Paper Series No. 20.*

UNDP Belarus (2020). What happens in Belarus due to climate change? Retrieved February 17, 2023 from https://www.undp.org/ru/belarus/chto-proiskhodit-s-izmeneniem-klimata-v-belarusi.

Varotto, A., & Spagnolli, A. (2017). Psychological strategies to promote household recycling. A systematic review with meta-analysis of validated field interventions. *Journal of Environmental Psychology*, *51*, 168-188.

Wachinger, G., Renn, O., Begg, C., & Kuhlicke, C. (2013). The risk perception paradox – implications for governance and communication of natural hazards. *Risk Analysis, 33,* 1049-1065. https://doi.org/10.1111.j.1539-6924-2012-01942.x

Whitmarsh L., O'Neill S. (2010). Green identity, green living? The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviors. *Journal of Environmental Psychology, 30(3),* 305– 314.

Wiernik M., et. Al (2013). Age and Environmental Sustainability: a Meta-Analysis. *Journal of Managerial Psychology, Vol. 28 No. 7/8,* 826-856.

Wooldridge, J. M. (2010). Econometric Analysis of Cross Section and Panel Data. In *MIT Press* (Vol. 58, p. 1096). https://doi.org/10.1515/humr.2003.021.

World Bank Group (2020). Strengthening Hydromet and Early Warning Services In Belarus – a Road Map.

Xiao C., McCright A.M. (2015). Gender Differences in Environmental Concern: Revisiting the Institutional Trust Hypothesis in the USA. *Environment and Behaviour, Vol. 47, Issue 1,* 17-37.

Zaalberg, R., Midden, C., Meijnders, A., & McCalley, T. (2009). Prevention, adaptation, and threat denial: Flooding experiences in the Netherlands. *Risk Analysis, 29,* 1759-1778. https://doi.org/10.1111/j.1539-6924.2009.01316.x

Zeng, J., Jiang, M., & Yuan, M. (2020). Environmental risk perception, risk culture, and pro-environmental behavior. *International journal of environmental research and public health, 17(5),* 1750. https://doi.org/10.3390/ijerph17051750

Annex

Table A1
Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Behavioral index	1029	23.862	4.207	9	36
Climate risk perception	1029	0.727	0.446	0	1
Exposure to extreme weather events	1029	0.184	0.387	0	1
Perceived environmental impact	1029	3.347	0.948	1	5
Climate TV	1029	1.790	1.234	0	4
Climate newspapers	1029	0.948	1.063	0	4
Climate Internet	1029	2.713	0.903	0	4
Climate radio	1029	1.150	1.067	0	4
Self-efficacy 1	1029	3.539	0.854	1	5
Self-efficacy 2	1029	3.467	0.892	1	5
Environmental beliefs 1	1029	3.631	0.894	1	5
Environmental beliefs 2	1029	3.787	0.975	1	5
Group activities 1	1029	2.058	0.652	1	4
Group activities 2	1029	1.532	0.688	1	4
Age	1029	41.033	13.199	18	75
Gender	1029	0.514	0.500	0	1
Income	1029	3.662	1.665	1	8
Education	1029	4.846	1.436	1	6
Household	1029	2.896	1.235	1	10
Region	1029	3.962	1.896	1	7

Table A2

Tests of overidentification, underidentification and weak identification for the instrumental variables

Test	Statistic
Sargan statistic (overidentification test of all instruments)	2.264
Chi-sq(1) P-val	0.132
Underidentification test (Anderson canon. corr. LM statistic)	47.873
Chi-sq(2) P-val	0.000

Weak identification test (Cragg-Donald Wald F statistic)	24.643