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The application of the contingent valuation method in estimating the climate change mitigation and adaptation policies in Greece. An expert-based approach

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Abstract When dealing with the ecological, social and economic impacts of climate change, it is important for each country to formulate and implement mitigation and adaptation measures. In this context, the present paper examines the application of the contingent valuation method (CVM) for the monetary estimation of the Greek national mitigation and adaptation climate change costs. To this purpose, the CVM in this case study has been applied to the Greek climate change experts only as, theoretically, they represent the most informed part of Greek society in technical and economic aspects of the climate change. Therefore, the findings of this paper express strictly the opinions of the national experts and are not representative of the general population. The monetary estimates include the experts' WTP for mitigation and adaptation measures as well as their preferences on that percentage of the national GDP that should be funding such measures at the present as well as the future time-scale. In addition, questions concerning the political and institutional climate change settings are included in the survey, providing a more comprehensive socioeconomic analysis in this particular study.

Keywords Contingent valuation · Climate change · Adaptation and mitigation costs · Experts analysis · Climate change costs

1 Introduction

The contingent valuation method (CVM) is applied in the present paper as an experts' evaluation approach in estimating the costs of climate change in Greece. Experts are a specific group, and there may be good reasons why their opinions might differ from those of a sample of random individuals responding to a CV survey. Still, the main question raised at this point is: Do experts know better than the average population? The

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answer to this question explains why the study applied CV exclusively to experts. Often enough, respondents to CV surveys do not have any experience with the alternative condition described in the valuation scenario. In other cases, they may not even have any experience with the baseline condition at all (Boyle et al. 1995). Thus, CV estimates on climate change mitigation and adaptation costs, crucially depend on the information presented in the survey instrument. Experts, on the other hand, are the citizens most informed on scientific and technical matters. Hence, they are expected to be familiar with the conditions of the economics of climate change in terms of both the present and the future.

The main objective of this paper is to valuate in monetary terms Greece's present and future mitigation and adaptation costs of climate change by applying the contingent valuation method (CVM) using solely the opinions of the experts. Furthermore, this research paper explores some important aspects concerning the evaluation of the country's climate change policies. Thus, such policy evaluations, as the monetary valuation is, are based on the preferences and the opinions of a defined sample of Greek experts on the economics of climate change. Technically speaking, the entire study is grounded strictly on the preferences of the experts—since they are regarded as the most informed part of the Greek population—and not on a random sample of individuals. By accepting this crucial assumption, we also accept that the experts, being the individuals who meet the criteria for carrying out such an evaluation, are the most appropriate ones for the task. Be that as it may, experts on the economics of climate change are not representative of the average population. Consequently, the results of the present research reflect exclusively the preferences of the experts and not those of the Greek population's sum total.

In this context, it is clear that if the same CVM had been conducted with a sample taken from the entire Greek population, the results would be an altogether different matter. Such an economic valuation coming from the total of the Greek population would have reflected the evaluation of an issue with strong environmental impacts that would be based on the preferences of individuals who are not well informed and, hence, are also little informed about the issue's impact on their welfare. In general, ordinary citizens are nevertheless considered capable of valuating that impact on their welfare since it derives from their acquisition or loss of goods, which they are in a position to understand. At present, the question whether citizens do have the ability to valuate in monetary terms environmental goods, which they have insufficient knowledge and personal experience of, has become the subject of debate (Vatn and Bromley 1995).

Valuating the mitigation and adaptation costs at a national level essays to overcome the above-mentioned knowledge and information restrictions. As a result, the study has applied the valuation to experts only. All of the experts chosen possess proven knowledge on the various aspects of climate change. Hence, they are indeed able to valuate the impacts of climate change on their welfare. This assumption is reinforced by the fact that it is an *ex-ante* evaluation of an exceptionally complicated and multi-dimensional issue. What is more, forecasts estimate that the climate change impacts, which emerged during the last decades, is on the rise showing signs of becoming even more intense in the future.

The present paper is structured as follows: the next section, Sect. 2, discusses the main theoretical framework on the economics of climate change. Next, Sect. 3 presents the contingent valuation method and its application on the economics of climate change. Then, Sect. 4 illustrates the methodological framework, while Sect. 5 analyses the findings. Finally, Sect. 6 brings the paper to its conclusion and discusses the results.

2 The economics of climate change: literature review

In recent years, an enormous amount of intensive research effort has gone into estimating the costs of climate change. The economics of climate change are classified into two major trends: the first one examines the economic costs and potential benefits that can derive from the physical and natural impact stemming from a changing climate. These economic impacts include the cost incurred when adapting to change as well as the economic consequences that linger after the adaptation process has been effected. The second one regards the economic costs that could be attributed to policies designed to mitigate climate change (Kolstad and Toman 2005). Given the inability to understand fully the science of climate change and gauge, the future with any clarity, estimates of the economic impacts by either trend are highly uncertain. What is more, as estimates by both trends evolve continuously over time, any estimate offered must be read with a sense of what was actually known at the time that the estimate was published.

The terms 'adaptation' and 'mitigation' are often used in the climate change literature in many different ways by a great variety of disciplines (Tobey 1992). By 'adaptation' economists mean actions undertaken once environmental change has occurred to minimize its negative effects or to take advantage of its beneficial ones. Adaptive activities can be divided into two categories: those that are purely private, and those that are public. In the case of the private ones, the costs and benefits of the adaptive activity accrue solely to the individual or firm undertaking the action. As a result, economic theory indicates that victims/beneficiaries of environmental change will undertake the economically optimal level of adaptation by acting in their own self-interest, without the contribution of the government (Oates 1983).

The second category of adaptation comprises public sector adaptive measures. Public sector involvement is economically justified when the benefits of adaptive activities come in the form of public goods. "Mitigation" of global warming involves taking steps to reduce greenhouse gas emissions: Hence, it aims at reducing the extent of global warming (IPCC 2007). The important economic policy aspect of climate change mitigation is that it produces benefits that extend beyond the individual firm or country undertaking the action: when the climate system is improved or protected, all residents who might have otherwise experienced undesirable change stand to gain (Tobey 1992).

The recent evolution of climate change economics is demonstrated mainly in two reports influencing public perception and the policymakers' attitudes. The first one is the Stern Review on the economics of climate change (Stern 2007), providing the basic economic principles of moving to a low-carbon economy as well as to adaptation strategies. The Stern Report also underlines the impacts of climate change on growth and development; the costs of stabilizing carbon emissions; and a comprehensive policy package necessary when dealing with climate change.

These estimates have provoked a debate in ecological economics (Weitzman 2008; Nordhaus 2008; Dasgupta 2007) with a focus on the selected discount rate and the valuation of future climate impacts in Stern's models. With regard to the latter focus, the criticism levelled against the Stern Review pointed to the underestimation of the impacts on non-market damages such us environmental goods (Sterner and Persson 2007; Neumayer 2007). Moreover, the Stern Review has been criticized because it advocated applying conventional methods of economic analysis to a problem for which they are unsuitable (Spash 2007) and not as definitive as presented. Be that as it may, due to the high publicity it has received, the Stern Review has had a powerful effect on governments and opened the road to dialogue on the economic impacts of climate change.

The second study influencing the economics of climate change is the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2007). Even though they do not provide estimations and models for the economic impacts of climate change, the IPCC reports are widely regarded as the most accurate reflection of climate science concerning climate causes and forecasts. Furthermore, the reports also analyze climate change impacts and vulnerabilities. In this context, the 4th IPCC Report carries the scientific basis for climate change economic estimations and wields influence on decision makers.

3 The contingent valuation method and its application on the economics of climate change

The contingent valuation method (CVM) is used in estimating economic values for ecosystem and environmental services. It serves to estimate both use and non-use values, and it is the most widely used method at times when non-use values are at stake (Bateman et al. 2002). Of all non-market valuation methods, it is also the most controversial one. Moreover, CVM is referred to as a "stated preference" method, because it requests people to state their values directly rather than infer values from actual choices, as the "revealed preference" methods do. The fact that CV is based on what people say they would do, as opposed to what people actually do is the source of its greatest strengths and its greatest weaknesses.

The purpose of the CVM is to elicit individual preferences, in monetary terms, for changes in the quantity or quality of non-market environmental goods. In the context of CVM, the valuation is dependent or 'contingent' on a constructed scenario where a sample of the population is interviewed and individuals are asked to state their maximum willingness to pay for (WTP) or minimum willingness to accept (WTA) an increase or decrease in the level of environmental quantity or quality (Cummings et al. 1986). Due to the fact that it creates a hypothetical marketplace in which no actual transactions take place, contingent valuation has been successfully used for commodities that are not exchanged in regular markets or in cases when it is difficult to observe market transactions under the desired conditions.

The conceptual, empirical, and practical problems associated with monetary estimates of economic value on the basis of how people respond to hypothetical questions on hypothetical market situations are the subject of constant debate in the economics literature. In this context, a great deal of dialogue addresses the use of CV concerning possible biases, protest bids, free-riders, etc. (Carson et al. 2001). Additionally, conducting a CV requires that special attention be focused on the design and implementation of the survey. The most important parameters of the survey design are: selection of the sample; pretesting of the survey; consultation with relevant experts; selection of the appropriate payment vehicle; selection of the appropriate interview vehicle (in-person, mail, or telephone surveys) and WTP elicitation format (Hoevenagel 1994).

With regard to the economics of climate change, several studies have used contingent valuation method (CVM) and other stated preferences methods to value the impacts of climate change on non-market goods. More specifically, Layton and Gardner (2000) used the conjoint analysis method to analyze the willingness to pay in order to prevent a long-term shift in the forest line caused by climate change. Berrens et al. (2004) applied the CVM to estimate American family willingness to pay in order to support the Kyoto Protocol. Fleischer and Sternberg (2005) used the choice modelling method to value the economic impact of global climate change on Mediterranean rangeland ecosystems.

Pendleton and Mendelsohn (1998) used the hedonic travel cost method and the random utility maximizing model to estimate the value of the impact of global warming on fish species. Moreover, Cameron (2004) applied a discrete-choice, stated preference method to estimate individual willingness to pay for climate change mitigation aspects.

In this context, a CVM approach with interviews addressed solely at the experts is applied here to estimate the present and future value of the mitigation and adaptation costs of climate change at Greek national level. The present study has selected to apply CV instead of other stated preferences methods due to the fact that, when it comes to environmental issues, this is the most rounded method. Compared to the choice modelling method and, more specifically, the conjoint analysis one, CV can provide a more comprehensive analysis since the survey includes questions addressing the broader institutional framework of the climate change policies.

4 Designing the survey

The first step towards structuring the survey was to define the valuation problem. In this context, the policy asset being valuated is the Greek national mitigation and adaptation climate change policy. Their valuation is an indirect way towards estimating the impacts of the climate change at the national level. According to the 4th IPCC Report, Greece, as a geographical part of the Mediterranean, appears to be a highly vulnerable area. More specifically, the IPCC 4th Assessment Report indicates that Southern Greece has the potential of becoming one of the regions most affected by climate change, a trajectory mainly expressed through higher incidence of heat waves and droughts. Moreover, it seems that Greece will be experiencing a longer and flatter tourism season. Occupancy rates (associated with a longer tourism season in the Mediterranean) will spread demand evenly and thus alleviate the pressure on summer water supply and energy demand. Mediterranean ecosystems may soon be among those most affected by global change drivers. Temperature increases in excess of 2°C could result in desert and grassland expansion and mixed deciduous forest expansion at the expense of evergreen conifer forests. Furthermore, warmer and drier conditions are partly responsible for the appearance of reduced forest productivity and increased forest fires. Both agriculture and forestry have shown vulnerability to recent trends of heat waves, droughts, and floods. Consequently, due to the severity of the climate change impacts in Greece, there is a need for comprehensive mitigation and adaptation policy measures. The valuation scenario of this research attempts to evaluate the national climate change policy framework.

At this point, it should be mentioned anew that the valuation of the mitigation and adaptation policy measures as well as the next steps of the survey entail only the opinions of the Greek experts on climate change issues. Hence, all the questions are designed in such a manner as to specifically elicit the preferences and the opinions of the experts since they are the ones in possession of the scientific knowledge on such a complex issue, especially where specific policy measures and different timescales are concerned.

The second step was to make preliminary decisions about the survey itself, including whether it would be conducted by mail, phone or in person; how large the sample size would be; who would be surveyed; and other issue-related questions. Finally, it was the in-person interviews that were selected as the most appropriate survey method since they elicit preferences in the most effective way concerning complex questions. It is often easier to explain the required background information to respondents in person, and people are more likely to complete a long survey when they are interviewed in person. As mentioned

before, it was decided that the sample of the surveyed population would be comprised of the national climate change experts alone since they are the most informed part of the total population. After researching the subject, 41 national experts were identified, representing different affiliations such as research, universities, environmental non-governmental organisations, public administration, etc. This size of the sample is small, as an absolute number, in order to conduct a CV. Nevertheless, it does contain all of the Greek experts identified as being active in a new national scientific sector. Furthermore, the majority of the identified experts (see Sect. 5) participated in the survey providing validated results concerning their preferences and attaching respectable scientific importance to the research findings.

The next step, which was the most important and difficult part of the process, was to design the survey, as well as construct the questionnaire, which was organized into four categories of questions:

4.1 Warm-up questions

Most contingent valuation surveys open with general ("warm-up") questions aiming at making respondents comfortable with their participation in the survey and with answering questions. To this purpose, the following two questions were structured:

- Is the climate change caused by natural processes or by human activities?

a	b	c	d	e	f
It is caused only by natural processes	It is primarily caused by natural processes and secondarily by human activities	Its caused both by natural processes and human activities	It is primarily caused by human activities and secondarily by natural processes	It is caused only by human activities	I don't know

- In your opinion, how important are the impacts of climate change in social, economic, and environmental terms?

Present

National Level

Not important at all	Somewhat important	Important	Important Enough	Very Important	I don't know

Global Level

Not important at all	Somewhat important	Important	Important Enough	Very Important	I don't know

Future (25 years from now)

National Level

Not important at all	Somewhat important	Important	Important Enough	Very Important	I don't know

Global Level

Not important at all	Somewhat important	Important	Important Enough	Very Important	I don't know

4.2 Eliciting monetary values

That was the most important part of the survey, including the payment questions and their attributes. In this case, two payment questions were included. The first included the individual willingness of the experts to pay for national mitigation and adaptation measures:

'Would you be willing to pay a national annual household fee for the mitigation and adaptation of the climate change? If no, go to the next question

Which is the reason why you are not willing to pay?
1. I don't believe in this approach
2. I don't know how much I am willing to pay
3. I can't afford to pay
4. It is an international issue and should be treated globally
5. The state should pay for this
6. I disagree in general and I'm not willing to pay
7. Other

(If yes) How much would you be willing to pay annually as a household for the mitigation and adaptation of the climate change at a national level?

2 €	200 €
5 €	300 €
10 €	500 €
20 €	800 €
30 €	1000 €
50 €	1500 €
100 €	2000 +€
150 €	

How would you distribute this value per category of mitigation and adaptation measures?

a. Mitigation

Percentage %

Percentage per mitigation measure
1. Improvement of the energy efficiency %
2. Promotion of new, low-carbon technologies %
3. Investment on renewable energy sources %
4 Reduction in the non-CO_2 emissions (land use, farming, stockbreeding) %
5 Other %

b. Adaptation

Percentage %

Percentage per adaptation measure
1. Restructuring of the economy (new cultivations, eco-tourism, etc) %
2. Infrastructures for protection from natural hazards (floods, droughts, forest fires, etc) %
3. Infrastructures for the creation of new water reservoirs %
4. Protection of the natural environment (rivers, forests, threatened species, marine ecosystems, etc.) %
5. Establishment of new institutional, regulatory and management structures %
6. Reform of the healthcare system %
7. Other %

The choice of the WTP and specifically the WTP to avoid is the benefit measure selected in order to avoid utility loss by paying for mitigation and adaptation actions. Additionally, WTP is defined as the amount that must be taken away from a person's income while keeping this person's utility constant:

$$V(y - \mathrm{WTP}, p, q_1; Z) = V(y, p, q_0; Z)$$

where V denotes the indirect utility function; y is the income; p is a vector of prices faced by the individual; while q_0 and q_1 are the alternative levels of the good or quality indexes (with $q_1 > q_0$, indicating that q_1 refers to improved environmental quality).

The payment vehicle of this question is a fee. As the long-term impacts of climate change must be taken into consideration, the payment is set on an annual time-basis with a lifetime being the timing of the provision. With regard to 'who will have to pay', the payment is allocated among all Greek households. However, as it has already been mentioned, since only the experts are surveyed, the results do not describe the preferences of the total population. Last, the elicitation format is the payment card.

The second payment question is an indirect WTP question and concerns the opinions of the experts on the GDP percentage that should be allocated now and again in 25 years for climate change mitigation and adaptation measures. The payment to be made 25 years into the future includes the requisite that the national climate change policy framework remain at the present conditions that are marked by lack of comprehensive and effective mitigation and adaptation. In other words, this future payment represents the costs of inaction.

'Which percentage of the National GDP should the Greek state provide for the mitigation and the adaptation of climate change?'

Present	**In 25 years (if the national climate change policy remains the same as today)**
No contribution	No contribution
0.01%	0.01%
0.05%	0.05%
0.1%	0.1%
0.25%	0.25%
0,5%	0.75%
0.75%	0.5%
1%	1%
1.5%	1.5%
2%	2%
2.5%	2.5%
3%	3%
4%	4%
5%	5%
6% +	6% +

How would you distribute this percentage of the GDP per category of mitigation and adaptation measures?

a. Mitigation

Percentage %
Present
In 25 years

Percentage per mitigation measure

Mitigation measures	Today	In 25 years
1. Reduction in the demand for carbon-intensive goods and services	%	%
2. Improvement of the energy efficiency	%	%
3. Promotion of new, low-carbon technologies	%	%
4. Investment on renewable energy sources	%	%
5. Reduction in the non-CO_2 emissions (land use, farming, stockbreeding)	%	%
6. Other	%	%

b. Adaptation

Percentage %
Present
In 25 years

Percentage per adaptation measure

Adaptation measures	Today	In 25 years
1. Restructuring of the economy (new cultivations, eco-tourism, etc)	%	%
2. Infrastructures for protection from natural hazards (floods, droughts, forest fires, etc)	%	%
3. Infrastructures for the creation of new water reservoirs	%	%
4. Protection of the natural environment (rivers, forests, threatened species, marine ecosystems, etc.)	%	%
5. Establishment of new institutional, regulatory and management structures	%	%
6. Reform of the healthcare system	%	%
7. Other	%	%

It should be reminded that the benefit measure selected for this payment question is a percentage of the GDP as an indirect WTP to avoid the negative impacts of the climate change at the national level. The payment vehicle of this question is a percentage of the Greek GDP. The timing of the payment is on an annual basis and the timing of provision is a lifetime, again in terms of the long-term impacts of the climate change. This question is asked in relation to two different time periods: the first one addresses the present when the impacts of climate change have already been emerged. The second period concerns the future, albeit not the distant one, translated as 25 years from now, when the impacts are expected to have become more intense. The question 'who will have to pay' entails a state payment and is thus a payment all the Greek citizens must have to make. Within this context, the experts are called upon to estimate the state resources for applying mitigation and adaptation measures. Once again, the elicitation format used is the payment card.

4.3 Attitudes and opinions

This part of the questionnaire includes additional questions that are quite important, aiming at evaluating the current climate change policies. In the first and second question, the experts are asked to state their satisfaction and optimism degree on a five-option scale. In the third question, the experts surveyed are free to choose more than one options or to add theirs concerning the obstacles which have emerged at the global level during attempts to manage the greenhouse effect efficiently. Finally, in the fourth question, they are called to state their opinion/alternatives on what the national climate change funding allocation per category of resources should be. More specifically, the questions take the following forms:

How satisfied are you from the present climate change policies?

1. National Level

1. Not satisfied at all | 2. Somewhat satisfied | 3. Satisfied | 4. Satisfied enough | 5. Very satisfied

2. European Level

1. Not satisfied at all | 2. Somewhat satisfied | 3. Satisfied | 4. Satisfied enough | 5. Very satisfied

3. Global Level

1. Not satisfied at all | 2. Somewhat satisfied | 3. Satisfied | 4. Satisfied enough | 5. Very satisfied

How optimistic are you about the way climate change is being treated?

1. Not at all | 2. Somewhat | 3. Somewhere in the middle | 4. Enough | 5. Very

At a global level, do you support that there do exist obstacles for efficient management of the greenhouse effect? If yes, what are these obstacles?

1. Interests of countries/groups of countries
2. Economic interests of companies/industries
3. Political interests
4. Lack of knowledge on how to manage the issue efficiently
5. Low awareness among citizens
6. Inadequate international institutional framework
7. The world's high growth rate
9. The world's high population rate
10. Other

In your opinion, what should be the financial contribution per resource for the mitigation and the adaptation of the climate change at the national level?

Categories of resources	**Percentage %**
1. State	
2. Industries	
3. New taxes imposed on all citizens	
4. European Union	
5. International Organizations	
6. Most polluting countries	
7. Other	

4.4 Demographics

The questions about socio-demographics are placed in the last portion of the survey questionnaire. In a typical manner, they look into the respondent's age, household income, marital status, educational attainment, and working affiliation.

The fourth and last step of the methodological framework was the pre-testing stage. During that step, successive meetings with selected experts took place in order to test the questionnaire before final application and correct any flaws. After a number of meetings had been conducted, the present study's researchers had obtained a clear idea of how the background information should be provided, the hypothetical scenario described, and the valuation questions asked.

5 Presentation and analysis of the survey findings

As the main part of the survey elaboration, the one-on-one interviews took place in the period between June 2007 and November 2007. By the end of that period, 30 out of the 41 identified Greek experts had responded to the research and accepted to arrange a personal interview in order to answer the survey's questions. Starting with the two warm-up questions the results are summarized in the following table.

The results of the first warm-up question indicated that the majority of the Greek experts (56.7%) follow the mainstream theory that perceives global warming as a problem mainly caused by those human activities that produce greenhouse gases. However, a strong percentage of the experts (33.3%) are more sceptical and maintain that climate change is caused both by human activities and natural processes.

The second warm-up question reveals two basic opinions. First, the Greek experts do recognize the increased importance of the climate change impacts at present-situation terms as well as future-situation ones. Still, they attach a higher degree of importance to the impacts at the global level rather than at the national level. Although Greece is among the most vulnerable areas, the experts' preference could be explained by two facts: for one thing, more attention is paid to climate change at global scale and, for another, few are the scientific studies that have dealt with climate change impacts at national level. Second, the experts attach a much higher degree of importance to the climate change impacts that will be brought about in the future (25 years from now) rather than in the present. As indicated in Table 1, the importance percentages of the fourth and the fifth options increase considerably when estimating the experts' opinion in the future situation. The explanation for this tendency may find an explanation in the recent pessimistic forecasts concerning the evolution of the global warming issue.

The most noticeable findings of the research are those concerning the willingness to pay (WTP) for the national climate change mitigation and adaptation measures. The findings of the two relevant research questions are presented separately. Table 2 presents the results for the experts' WTP for an annual household fee. The statistical factors that have been analyzed concerning the WTP estimations are the arithmetical mean and the standard deviation.

According to the findings depicted in Table 2, 60% of the Greek experts state that they would be willing to pay an annual household fee for national mitigation and adaptation measures. The remaining 40% are not willing to pay for such purposes. Half of those who were negative, justified their answer by stating that they disagreed with that approach. Thus, their opinion has been recorded as a zero bid. The remaining 50% of those not

Table 1 Main findings of the warm-up questions

Question	*n*	%
1. Is the climate change caused by natural processes or by human activities?		
a. It is caused only by natural processes	0	0.0
b. It is primarily caused by natural processes and secondarily by human activities	1	3.3
c. It is caused by both natural processes and human activities	10	33.3
d. It is primarily caused by human activities and secondarily by natural processes	17	56.7
e. It is caused only by human activities	2	6.7
2. In your opinion, how important the impacts of climate change in social, economic, and environmental terms are?		
Present—national level		
a. Not important at all	0	0.0
b. Somewhat important	6	20.0
c. Important	11	36.7
d. Important enough	9	30.0
e. Very important	4	13.3
Present—global level		
a. Not important at all	0	0.0
b. Somewhat important	2	6.7
c. Important	10	33.3
d. Important enough	14	46.7
e. Very important	4	13.3
In 25 years—national level		
a. Not important at all	0	0.0
b. Somewhat important	0	0.0
c. Important	3	10.0
d. Important enough	14	46.7
e. Very important	12	40.0
f. I don't know	1	3.3
In 25 years—global level		
a. Not important at all	0	0.0
b. Somewhat important	0	0.0
c. Important	0	0.0
d. Important enough	13	43.3
e. Very important	16	53.3
f. I don't know	1	3.3

willing to pay state that the climate change is a global issue, and thus they refuse to pay since they argue that mitigation and adaptation measures should be planned and implemented at a global level, within the framework of international cooperation. This form of negative responses are marked as protest bids and have been excluded from the analysis.

With regard to the WTP, the main findings can be summarized as follows: first, the total WTP mean is 229, i.e., 58 euros, an absolute monetary value that is quite high. The total

Table 2 WTP estimations for mitigation and adaptation costs

Acceptance of the valuation scenario	*n*	%
Would you be willing to pay a national annual household fee for the mitigation and adaptation of the climate change?		
No	12	40.0
a. Protest bids	6	50
b. Zero bids	6	50
Yes	18	60.0
WTP estimations	**Mean WTP (€)**	**SD**
Mitigation total	156.88	305.07
1. Improvement of the energy efficiency	37.98	85.82
2. Promotion of new, low-carbon technologies	44.11	120.55
3. Investment on renewable energy sources	55.73	105.98
4. Reduction of non-CO_2 emissions (land use, farming, stockbreeding)	18.76	31.11
5. Other	0.35	1.13
Adaptation total	72.71	111.38
1. Restructuring of the economy (new cultivations, eco-tourism, etc.)	14.35	26.49
2. Infrastructures for protection from natural hazards (floods, forest fires, etc.)	12.24	18.70
3. Infrastructures for the creation of new water reservoirs	13.99	22.95
4. Protection of the natural environment (rivers, threatened species, marine ecosystems, etc.)	11.66	17.17
5. Establishment of new institutional, regulatory, and management structures	13.11	24.11
6. Reform of the healthcare system	5.15	9.46
7. Other (climate change refugees)	2.65	10.05
Total WTP for mitigation and adaptation	229.58	406.21

amount is mostly allocated to mitigation measures (156.88 euros), while a smaller amount is allocated to adaptation measures (72.71 euros). The explanation for the lion's share going towards mitigation measures may be explained as stemming from the debate at an international level for the reduction in greenhouse gases aiming at limiting global warming. In contrast, adaptation measures are related to the emergence of the impacts which at present are mildly severe. With regard to the mitigation measures, Greek experts seem to pay more attention to the development of a renewable energy infrastructure, followed by measures related to emissions reduction ("Improvement of energy efficiency" and "Promotion of new, low-carbon technologies"). As far as the adaptation costs are concerned, the WTP mean total adaptation is almost evenly distributed between the first five measures, something that comes to underline their importance.

The findings of the second payment question (GDP estimates) indicate a high-interest degree. The results on the percentage of the present and the future GDP that should be allocated for mitigation and adaptation measures are presented in Table 3. Similarly to WTP estimations, the arithmetical mean and the standard deviation are the statistical factors under analysis.

As illustrated in Table 3, the total mean percentage of the Greek GDP for the present is high (1.71%), while for the future projection (25 years from now), the experts consider that the GDP percentage going towards mitigation and adaptation measures will be raised up to 2.75% if the national climate change policy of that time has remained the same with the present one. Given that the GDP in 2008 was 242,946 million euro (Source: National Statistic Service), the above percentages are translated into 4,154 million euro and 6,681 million euro, respectively (in 2008 prices). This rise in the GDP slated for mitigation and adaptation may be partially explained by the pessimistic forecasts regarding the evolution of the global warming.

As with the WTP estimates, the same picture emerges in the case of the total GDP percentage allocation. In view of that similarity, the present percentage allocation of total GDP shows an uneven distribution between mitigation (1.13%) and adaptation (0.58%) measures, demonstrating again the need for policies and measures leading to the reduction of greenhouse gases. However, with regard to the future projection (25 years from now), these estimates shift and a more balanced allocation emerges attributing 1.45% of the GDP to mitigation and 1.30% to adaptation. Again, it is the concerns that in 25 years from now, the climate change impacts will be more severe that explains this balanced picture. The renewable energy infrastructures remain the most popular mitigation measure both in terms of the present (0.35% of the GDP) and the future (0.44% of the GDP). It is followed by the first three measures for reduction of CO_2 emissions. Adaptation measures, in terms of both the present and the future show a balanced allocation of the total adaptation GDP, with infrastructures for new water reservoirs and protection from natural hazards gaining popularity in the future.

As mentioned before, the attributes-and-opinion questions were structured so that the general climate change policy framework may be evaluated. The main results are presented in Table 4.

According to the results of the first question, the Greek experts appear to be mostly and highly dissatisfied with national climate change policies, with dissatisfaction over international climate change policies coming in second place. The experts' first and main dissatisfaction seems to lie with the inadequate and scope-limited Greek policy settings and initiatives, while the second one could be explained by the inefficiency of the international community, which has yet to achieve common targets and drastically reduce greenhouse emissions. In contrast, as a result of the several initiatives adopted by the European Union

Table 3 GDP estimations for present and future mitigation and adaptation costs

GDP estimations for mitigation and adaptation		
Which percentage of the national GDP should the Greek state provide for mitigation and adaptation of the climate change?	Mean GDP (%)	SD (%)
Present context		
Mitigation total	1.13	1.12
1. Reduction in the demand for carbon-intensive goods and services	0.19	0.21
2. Improvement of energy efficiency	0.28	0.38
3. Promotion of new, low-carbon technologies	0.20	0.16
4. Investment on renewable energy sources	0.35	0.49
5. Reduction of the non-CO_2 emissions (land use, farming, stockbreeding)	0.12	0.14
6. Other (research—education)	0.02	0.05
Adaptation total	0.58	0.68
1. Restructuring of the economy (new cultivations, eco-tourism, etc.)	0.12	0.14
2. Infrastructures for protection from natural hazards (floods, forest fires, etc.)	0.10	0.12
3. Infrastructures for the creation of new water reservoirs	0.11	0.13
4. Protection of the natural environment (rivers, threatened species, marine ecosystems, etc.)	0.12	0.17
5. Establishment of new institutional, regulatory, and management structures	0.09	0.11
6. Reform of the healthcare system	0.05	0.08
7. Other (climate change refugees)	0.01	0.04
Total GDP for mitigation and adaptation	1.71	1.45
Future context (25 years from now provided that future policy is identical with present policy)		
Mitigation total	1.45	0.97
1. Reduction in the demand for carbon-intensive goods and services	0.21	0.21
2. Improvement of energy efficiency	0.30	0.21
3. Promotion of new, low-carbon technologies	0.33	0.34
4. Investment on renewable energy sources	0.44	0.41
5. Reduction of the non-CO_2 emissions (land use, farming, stockbreeding)	0.14	0.12
6. Other (research—education)	0.01	0.04
Adaptation total	1.30	0.88
1. Restructuring of the economy (new cultivations, eco-tourism, etc.)	0.17	0.14
2. Infrastructures for protection from natural hazards (floods, forest fires, etc.)	0.29	0.21
3. Infrastructures for the creation of new water reservoirs	0.31	0.28
4. Protection of the natural environment (rivers, threatened species, marine ecosystems, etc.)	0.23	0.19
5. Establishment of new institutional, regulatory, and management structures	0.16	0.16
6. Reform of the healthcare system	0.11	0.09
7. Other (climate change refugees)	0.02	0.06
Total GDP for mitigation and adaptation	2.75	1.55

on the issue, the experts' degree of satisfaction with regard to the European policy framework marks an increase.

Although Greek experts do not appear satisfied enough about the climate change policy context, in total, more than the half of them state themselves as being optimistic over the

Table 4 Findings on the opinion-and-attitude questions

Question	*n*	%
1. How satisfied are you with the present climate change policies?		
National level		
a. Not satisfied at all	19	63.3
b. Somewhat satisfied	10	33.3
c. Satisfied	1	3.3
d. Satisfied enough	0	0.0
e. Very satisfied	0	0.0
European level		
a. Not satisfied at all	0	0.0
b. Somewhat satisfied	11	36.7
c. Satisfied	14	46.7
d. Satisfied enough	5	16.7
e. Very satisfied	0	0.0
Global level		
a. Not satisfied at all	7	23.3
b. Somewhat satisfied	21	70.0
c. Satisfied	2	6.7
d. Satisfied enough	0	0.0
e. Very satisfied	0	0.0
2. How optimistic are you about the way climate change is being treated?		
1. Not at all	1	3.3
2. Somewhat	12	40.0
3. Somewhere in the middle	14	46.7
4. Enough	2	6.7
5. Very	1	3.3
3. At a global level, do you agree that there do exist obstacles to managing the greenhouse effect efficiently? If yes, what are these obstacles?		
1. Vested interests of countries/groups of countries	23	76.7
2. Economic interests of companies/industries	28	93.3
3. Political interests	11	36.7
4. Lack of knowledge on how to manage the issue efficiently	7	23.3
5. Low awareness among citizens	14	46.7
6. Inadequate international institutional framework	15	50.0
7. The world's high growth rate	3	10.0
9. The world's high population rate	5	16.7
10. The solution to this problem is quite complex	1	3.3
4. In your opinion, what should the financial contribution be (per resource) for mitigation and adaptation of the climate change, at the national level?		
1. State		20.2
2. Industries		41.0
3. New taxes imposed on all citizens		7.2
4. European Union		12.5
5. International organizations		5.3
6. Most polluting countries		13.5
7. Other		0.3

way the global warming is being treated. However, a large number of them also declares themselves as being quite pessimistic. The analysis of the results the third question has had reveals that all of the Greek experts queried stated that there do exist obstacles in managing the greenhouse effect at the global level. An exceptionally high percentage (93.3%) indicated that the most important obstacle is the vested economic interests of large companies and industries. It was closely followed by another high percentage (76.7%) of experts stating that another hurdle is the vested interests of countries or groups of countries. An insufficient international institutional framework; low awareness among citizens; and political interests also emerged as crucial obstacles to greenhouse effect management at global level.

As expressed through the fourth question, the experts' opinion on the financial allocation of the national mitigation and adaptation measures was that 41% of funding resources should be paid by the polluting industries, something which strongly advocates the "polluters-pay" principle. Moreover, their second preference (20.2%) indicated Greek state funding as an alternative. With regard to the issue's international dimension experts declared that 13.5 and 12.5% of national resources should be funded by the most polluted countries and the European Union, respectively.

Last, the main demographic characteristics of the sample have as follows: 63.3% of the experts were men and 36.7% women. They were all highly educated since 26.7% of them held a post-doctoral degree; 33.3% held a PhD; and 36.7% of the experts held a MSc degree. The experts' household income places most of them at a mid-, mid-to-high income level. Moreover, 40% of the experts are currently employed at Universities; 16.7% in research institutions; 16.7% in the broader public sector; 13.3% are absorbed by environment-related NGO's; and another 13.3% work in the private sector.

6 Conclusions and further discussion

In the present paper, the CVM has been applied as an alternative to the mainstream integrated assessment models so that mitigation and adaptation costs may be estimated in monetary terms, in the Greek national context. Based on the premise that experts on Greek climate change are the part of the population most informed on such a complex issue, the analysis took into account only the preferences of those experts. The mean WTP, as an annual household payment, was stated by the experts to stand at 229.58 euro, an amount mostly allocated to mitigation measures. Additionally, provided the policy framework remains as is, the experts stated that the national GDP's present 1.71% and future 2.75% should go towards mitigation and application measures. Similarly to the WTP, on the present-time scale, the experts slated the largest part of this GDP percentage for mitigation measures, a preference greatly influenced by the international debate on and efforts for reduction of greenhouse emissions. However, when it came to the future, experts stated that this part of the GDP should be more evenly allocated between mitigation and adaptation measures.

From an informal point of view, these GDP estimations could confront the findings of the Stern Review, even though different methodologies were applied. In the Stern Review, the economic impacts of climate change were based upon Macroeconomic Models and specifically Integrated Assessment Models. In this context, the Stern Review has used economic modelling which led to the conclusion that unless action were taken on climate change, the costs and risks of future climate change would result in a 5–20% loss in GDP.

At the same time, the costs of reducing greenhouse gases in order to avoid the worst of impacts could shrink to one per cent of GDP (Stern 2007).

Furthermore, in the climate change policy context, some very important findings have been revealed. They mainly concern the importance of climate change impacts; the degree of satisfaction and optimism among experts; the obstacles that arose in managing the problem; and the national funding alternatives. It should be reminded at this point that both the WTP and GDP estimations as well as the rest of the opinions do not represent the preferences of the wider Greek population. As it has been mentioned before, despite its small sample size, the survey's validity is satisfactory since the majority of the limited number of experts in this specific field participated in this research. However, the research's methodology and findings could very well act as a potential scientific challenge if applied to a sample of the general population. Moreover, the CVM estimates deriving from this paper may also prove of use to the relevant authorities, acting as a driver for policymaking and the formulation of the institutional arrangements pertinent to the national climate change policy agenda.

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