HOW CAN EUROPEAN GOVERNMENTS STIMULATE THE PURCHASE OF ENVIRONMENTALLY FRIENDLY VEHICLES? A MULTI-ACTOR MULTI-CRITERIA ANALYSIS.

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ABSTRACT

This paper makes use of the multi-actor multi-criteria analysis (MAMCA) methodology in order to investigate how governments in EU Member States can stimulate consumers in buying environmentally friendly vehicles using car taxation policies. Four commonly used taxation policies are evaluated: tax reductions for vehicles with alternative fuel systems (hybrids, electric vehicles, LPG, CNG, biofuels...), incentives based on the level of CO_2 emission, financial incentives for vehicles equipped with a particulate matter filter and finally scrapping premiums for customers who replace their vehicle with a more environmentally friendly one. With the use of the MAMCA approach, these common trends are evaluated on the basis of 4 criteria: the economic impact, the environmental impact, the social impact and the level of transparency. Thanks to the MAMCA approach, the point of view of 5 different stakeholder groups is taken into account. These stakeholders include the users, the government, non-governmental organizations, experts from the automotive industry and specialized academic researchers. The results of this analysis show that scrapping premiums are considered the best option in the attempt to green the car fleet, as it replaces old and polluting vehicles with environmentally friendly types. Next up are the incentives for alternative fuel systems, followed by the CO_2 emission based incentives and the particulate matter based incentives.

Keywords: Car taxation, environmentally friendly vehicles, MAMCA

1. INTRODUCTION

Throughout the last decades, transportation by car has grown significantly and European citizens can hardly imagine a life without the freedom granted by this mean of transportation. Nevertheless, car usage has a large environmental impact, as almost 12% of the total EU emission of carbon dioxide (CO_2) comes from the fuel consumed by road vehicles (European Commission, 2007a). And even though technological improvements from the automotive industry already proved the possibility of emission reduction from cars, the increasing amount of kilometers driven and the high level of comfort needed to please the consumers entail that the total environmental impact still remains high.
In its attempt to lower the toxic emissions from car transportation, the European Commission already proposed a series of fiscal measures to reduce CO_2 emissions from cars (see European Commission, 2002).
The European Commission (2007b) declares that three major stakeholders are involved in the issue of green car taxation. The first group includes the consumers of motor vehicles. They are affected by the purchase price of passenger cars and by fluctuating running costs of the vehicle which are correlated with possible tax reductions linked with CO_2 emissions and with improvements in fuel consumption (European Commission, 2007b). Not only are these consumers affected on a financial point of view, ever since carmakers have uncovered the trend towards greener cars, they have shifted the focus from luxury items (e.g. heated and ventilated seats, entertaining systems, etc.) and design to environmental aspects (Kågeson, 2005). Next, the European Commission highlights the share of the entire EU population, which is affected by the climate change partially due to the increase of toxic emissions in transport. The final group comprises the car manufacturing industry, which faces the heavy duty to transform their portfolio into a more environmentally friendly one. However, this challenge is clearly divergent amongst the different carmakers as Ferrari, Bentley and other exclusive car manufacturers just cannot introduce a car with a CO_2 emission of 120 g/km. Several brands like Mercedes-Benz and BMW have tackled this issue by enlarging their product portfolio on the compact car side, with respectively the A-Class and the 1-Series, and with the inclusion of the brands Smart and Mini in their product portfolio.
Alongside the stakeholder groups given by the European Commission, this research includes several extra stakeholder groups, who are at least as important as the ones given by the European Commission. Governments are the institutions that have the unique ability to implement new taxation systems and they should thus be present throughout the decision making process. Nongovernmental organizations (NGOs), consulting companies, universities and other knowledge based institutions have the task of evaluating different breakthrough alternatives.

This paper starts with a clarification of the decision making theory used in the research methodology. Then, with the input of a recent study on fiscal policy measures used in 15 European countries, the 4 most commonly used taxation incentives are evaluated through a multi-actor multi-criteria analysis (MAMCA) approach, in order to find the most interesting incentive that European governments can implement to stimulate the sales of environmentally friendly vehicles. Using the MAMCA approach entails including the point of view of multiple stakeholder groups. Finally, using specialized decision making software, the results of the MAMCA are investigated to provide policy makers with a better understanding in this environmental challenge.

2. DECISION MAKING THEORY

For the evaluation of transportation projects, multiple methods can be applied. The 5 most commonly used methods are the private investment analysis, the cost-effectiveness analysis (CEA), the economic-effects analysis (EEA), the social cost-benefit analysis (SCBA) and the multi-criteria decision analysis (MCDA) (Macharis et al, 2009a).
The Analytic Hierarchy Process (AHP) is a well known MCDA theory, where pairwise comparisons are used to derive the priorities from experts (Saaty, 2008). It was developed in the 1970s by Saaty and has been used in many research fields such as economics and planning, marketing, project selection and budget allocation. For an overview of AHP applications, see Zahedi (1986) and Vaidya et al. (2004).
The AHP methodology is structured in 4 steps (Saaty 2008). First, the problem is defined. Next, the decision hierarchy tree is produced, including the different objectives and alternatives. Then, pairwise comparison matrices are constructed. And finally, using the priorities obtained from the comparison in step 3, the overall ranking is shown.
Why is AHP such a widely used MCDA method? In a survey with academic researchers and top level decision makers in large multinational corporations, several reasons are highlighted (Saaty, 2006). Despite the relative mathematical complexity, the level of user friendliness seems to be one of the most important motives, together with the availability of specialized software and the inclusion of both tangible and intangible judgments. Moreover, AHP allows the decision maker to form a hierarchy at the end of the evaluation process, together with the possibility of sensibility analysis. For this specific project, the inclusion of pairwise comparisons raised the level of visibility for the evaluators as it requires little additional skills or foreknowledge in evaluation techniques.

The MAMCA methodology (Macharis 2000 & 2007; Macharis et al. 2009a & 2009b) makes use of the AHP approach, but while AHP focuses on the evaluation of 1 stakeholder, the MAMCA method is described as a methodology to evaluate different alternatives taking into account different stakeholders' opinions (Macharis et al., 2009b). Including different stakeholders in multi-criteria decisions, and more specifically linking the findings of researchers with the stakeholders' point of view, is highly important (Van Ham & Van Wee, 2003, Walker, 2000). In the end, this process is more time consuming, but the likelihood of acceptance of the proposed solution will be higher (Macharis, 2004).

The analysis consists of 7 steps, as illustrated in figure 1.

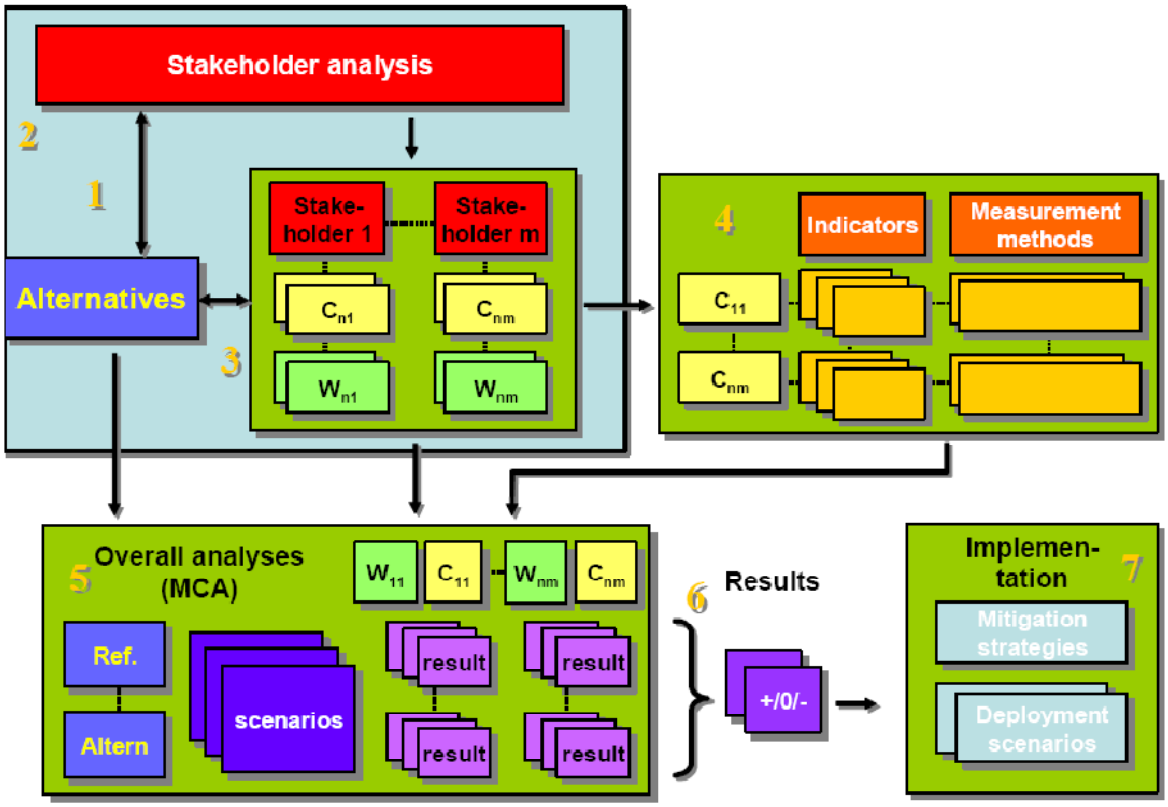

Figure 1 – The 7 steps of the MAMCA methodology (Macharis et al., 2009a)

The MAMCA is able to support the decision maker in his final decision as the inclusion of the different points of view leads to a general prioritization of proposed policy measures. Overall, the methodology consists of 7 steps. The first step is the definition of the problem and the identification of the alternatives. Next, the various relevant stakeholders, as well as their key objectives, are identified. Thirdly, these objectives are translated into criteria and then given a relative importance (weights). Fourthly, for each criterion, one or more indicators are constructed (e.g. direct quantitative indicators such as money spent, number of lives saved, reductions in CO_2 emissions achieved, etc.) or scores on an ordinal indicator such as high/medium/low for criteria with values that are difficult to express in quantitative terms. The measurement method for each indicator is also made explicit (for instance willingness to pay, quantitative scores based on macroscopic computer simulation etc.). This permits measuring each alternative performance in terms of its contribution to the objectives of specific stakeholder groups. Steps 1 to 4 can be considered as mainly analytical, and they precede the "overall analysis", which takes into account the objectives of all stakeholder groups simultaneously and is more synthetic in nature. The fifth step is the construction of the evaluation matrix, aggregating each alternative contribution to the objectives of all stakeholders. Next, the multi-criteria analysis yields a ranking of the various alternatives and reveals their strengths and weaknesses. The stability of the ranking can be assessed through sensitivity analyses. The last stage of the methodology includes the actual implementation of the policy measure.

In the past, the MAMCA methodology has already proven its usefulness for several transport related decision problems such as the evaluation of the location of intermodal terminals (Macharis, 2000), the evaluation of mobility rights (Crals et al., 2004), the evaluation of driver assistance systems (Macharis et al., 2004), the evaluation of waste transport in the Brussels region (Macharis & Boel, 2004) and the masterplan for the port of Brussels (Dooms et al., 2004). For a complete overview of theory and applications of the MAMCA methodology, see Macharis et al. (2009a).
It is important to notice that the MAMCA methodology, like many other multi-criteria analyses, does not render the final and optimal solution to a given problem. Moreover it must be seen as a tool that helps the decision maker with his choice. After the MAMCA has been completed, the decision maker should carefully examine the outcome of the analysis in order to implement the most optimal alternative.

3. MULTI-ACTOR MULTI-CRITERIA ANALYSIS (MAMCA)

In this section, the MAMCA is used for the evaluation of 4 incentives linked to the registration tax, as used in 15 European countries. The goal is to find the preference of the included stakeholder groups in order to facilitate the decision making process of the policy makers in the EU Member States. All 7 steps of the MAMCA are addressed in this section, except for step 7 (implementation of the results), as this is beyond the scope of this paper.

Step 1: Defining the problem and the alternatives

The investigated problem in this paper can be formulated as follows: *Which of the 4 given policy measures is preferred in making environmentally friendly vehicles more attractive for the customer?* As for the alternatives, the 4 policy measures include: bonuses for clean vehicle technologies, CO_2 incentives, particulate matter incentives and scrapping premiums. A previous study (Lebeau et al., 2010) revealed that up to March 2009, a total of 9 different financial incentives with regard to the registration tax were implemented in 15 European countries. Table 1 illustrates the frequency of these financial incentives used in the investigated countries.

Table I – Frequency of financial incentives with regard to registration tax in Europe

Special incentive	Frequency	Countries
Alternative fuels	7	Austria, Cyprus, Denmark, Ireland, Italy, Portugal and Spain
Scrapping premiums	6	Belgium[1], France, Germany, Italy, Luxemburg and Spain
Particulate matter incentive	5	Austria, Belgium, Germany, Portugal and Luxemburg
CO_2 incentive	4	Austria, Belgium, Cyprus and Luxemburg
CO_2 deduction for large families	2	France and Spain
Safety incentives	1	Denmark
Classic cars	1	Italy
Provincial registration tax	1	Italy
Conversion to LPG/CNG	1	Italy

Source: Lebeau et al., 2010
(CO_2 = carbon dioxide, LPG = liquefied petroleum gas, CNG = compressed natural gas)

In this paper, only the four most commonly used incentives will be evaluated: tax reductions for vehicles with alternative fuel systems, scrapping premiums, financial incentives for vehicles equipped with a particulate matter filter, and incentives based on the level of CO_2 emission. The first MAMCA alternative is the incentive for alternative fuel systems. Clean vehicle technology incentives are given to consumers that buy a car equipped with new environmentally friendly technology. This includes hybrid vehicles, electric cars, cars that can run on biofuels, etc. Seven European countries already adopted measures that favor environmentally friendly technologies. Next, one of the most popular policy measures during the last few years, the scrapping premium, is included in this research. When replacing an old and polluting vehicle with a new environmentally friendly one, consumers receive a financial bonus. In March 2009, only 6 European countries had implemented this measure, but during the remaining months in 2009, many countries implemented this measure, most often in order to cope with the crisis in the automotive industry. As a third alternative, the particulate matter incentives are given to consumers when their newly purchased vehicle is equipped with a particulate matter (PM) filter. Obviously, this measure only targets diesel cars, as petrol vehicles have no particulate matter emission. Five European countries have inserted a PM incentive in their car taxation system. Finally, the CO_2 incentives are defined as financial advantages given to citizens that buy a new vehicle with a low CO_2 emission. The government only takes into account the CO_2 emission, and not the technology used in the vehicle. Four countries already implemented such an incentive. The purpose of this research is to find which of the 4 given policy measures is preferred by the stakeholders in order to promote the purchase of environmentally friendly vehicles.

Step 2: Stakeholder analysis

The MAMCA approach differentiates itself from other multi-criteria analyses by including the notion of stakeholders and by investigating their opinion on the given research question. Stakeholders can be defined as the range of people who are likely to use a system or who can be influenced either directly or indirectly by the system (Macharis & Stevens, 2003). In

[1] The scrapping scheme in Belgium is only applied in the Walloon region and is not named “a scrapping scheme”, even though it includes many aspects of this policy measure. Therefore, it is included in this research, but not in many overviews of scrapping schemes in Europe.

this analysis, 5 stakeholder groups are included: the users, the government, non-governmental organizations, experts of the automotive industry and academics. Every stakeholder group was given an equal weight of 20 percent.
It must be underlined that this analysis aims to be qualitative rather than quantitative with respect to the number of evaluators included. Hence, some of the stakeholder groups consist of a limited number of stakeholders, but all are highly qualified in representing their group.

The user group includes 5 Belgian citizens who all have a driving license and who are familiar with the process of buying a new car. This group is the target group for the new policy measure as they are faced with the decision of buying new cars. The governmental stakeholder group consists of two highly qualified persons who are employed at the Belgian government and at the Belgian department of mobility. They represent the voice of the government who, especially during the last few years, is urged to implement new financial measures in order to promote environmentally friendly vehicles. Next, the view of the non-governmental sector was given by a person that holds a high position at the Belgian federation of 150 environmental associations in Flanders (BBL). To include the view of the automotive industry, 8 people employed in this industry filled in the questionnaire. Jobs range from automotive consulting firms to leasing companies and from Belgian automobile distributors to automotive marketing bureaus. Finally, the input of the academic world was achieved through the voice of 5 academic researchers, all working in the field of transport and mobility.

Step 3: Defining criteria and weights

In several previous MAMCA applications, stakeholder groups had their own specific criteria on which the proposed alternatives were evaluated (Macharis & Stevens, 2003; Macharis, 2004). Other applications (Macharis, 2009b) made use of identical criteria for every stakeholder group. In this paper, the latter method is used: the 4 identified criteria were evaluated by the academic team that was in charge of this research project. The following 4 criteria are used in the survey:

1. *Economy*: will the measure stimulate the economy? The new policy measure should at least keep the current economic flow at level, but preferably, the sales of environmentally friendly vehicles should be augmented. Above that, the level of country specific parameters such as GDP, GNP, import and export should remain at least constant.

2. *Environment*: will the measure entail a less negative impact on the environment? Keeping in mind that the transport sector is one of the major actors in the global warming process, policy makers could correlate car taxation systems more with environmental aspects such as CO_2 emission.

3. *Social*: will the measure be fair for different layers of the society? Banning every old vehicle from the road would lower CO_2 emissions, but the government must keep in mind that these cars are often driven by citizens with fewer financial means. Future car taxation systems should be balanced and evaluated for every income bracket.

4. *Transparency*: will the measure be easy to understand? There is no need for a car taxation system no one can comprehend. The level of simplicity differs greatly throughout European countries (ACEA, 2008). For instance, Portuguese citizens have to multiply each g/km CO_2 with a specific factor and afterwards deduct a predetermined amount. When they buy a new car, they have no idea of the amount of taxes that have to be paid. On the other hand, Cyprus has an extremely simple tax method, which is similar for both the registration and the ownership taxes and only uses CO_2 emissions and a discount factor.

These 4 criteria are somewhat limited in scope to be extremely meaningful. However, they enable the decision maker to have a general hierarchy of the policy measures, before going into more detailed analyses.

In order to let the stakeholders express their subjective preference for the different criteria with respect to the alternatives, they were prompted to distribute the weight through a point allocation method. A total of 100 points had to be allocated between the 4 criteria. The weight distribution for all stakeholders is illustrated in figure 2.

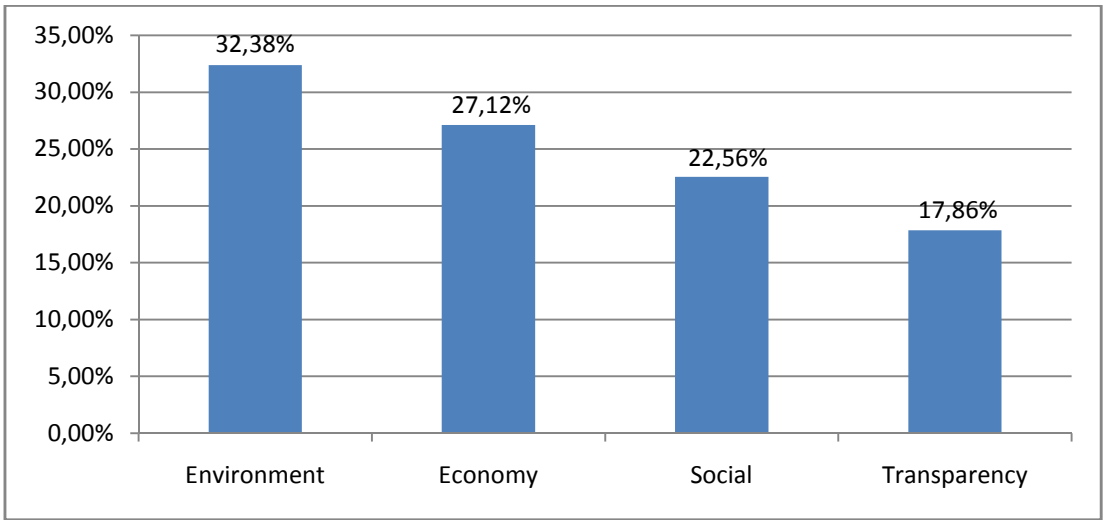

Figure 2 – Weight distribution for the four criteria, all stakeholders included.

The environmental criterion scored on average 32.38%. Hence many stakeholders find that future car taxation should focus more on the environmental aspects and consequences of transport. Next, the economy should not be negatively impacted due to new car taxation methods. On average 27.12% was given to this criterion. The social aspect of car taxation occupies the third place in this classification (22.56% on average), while transparency is seen as a less important factor for new policy measures (17.86% on average).

Step 4: Measurement methods

In contrast with the weight allocation by the stakeholders as explained in step 3, the measurement for the preference of the alternatives follows the pairwise comparison procedure, as developed by Saaty (1980). Cognitive psychologists refer this as the relative comparison method, as opposed to the absolute comparison method used in step 3 (Saaty, 2006). This paper uses the Saaty scale as shown in table 2.

Table II – The Saaty scale for pairwise comparison

	Definition	Explanation
1	Both elements have equal importance	Both elements contribute equally to the criterion considered
3	Moderately higher importance of row element (RE) as compared to column element (CE)	Experience and judgment reveal a slight preference of RE over CE
5	Higher importance of RE as compared to CE	Experience and judgment reveal a strong preference of RE over CE
7	Much higher importance of RE as compared to CE	RE is very strongly favoured over CE, and its domination has been demonstrated in practice
9	Complete dominance in terms of importance of RE over CE	The evidence favouring RE over CE is of the highest possible order of affirmation
2, 4, 6, 8 (intermediate values)		An intermediate position between two assessments
1/2, 1/3, 3/4, … 1/9 (reciprocals)		When CE is compared with RE, it receives the reciprocal value of the RE/CE comparison
Rationals: Ratios arising from the scale		If consistency were to be forced by obtaining *n* numerical values to span the matrix
1.1-1.9: For tied activities		RE and CE are nearly indistinguishable; moderate is 1.3 and extreme is 1.9

Source: Saaty, 2008

The use of a scale going from 1/9, 1/7, 1/5, 1/3, 1, 3, 5, 7 to 9 can be explained with a simple example (Saaty, 2008). If one analyzes 2 comparable goods like coffee and wine, he or she will express his or her preference by indicating that coffee is 9 times more preferable than wine. Hence, a score of 9 will be distributed to the position (coffee, wine). Automatically, the inverse position (wine, coffee) will be allocated as the reciprocal of the first position: 1/9. This means that wine is 1/9 times more preferable than coffee. This way, the number of preference choices that has to be made in the survey is halved immediately. For this case, the stakeholders had to choose between 9 possibilities, which are shown in table 3.

Table III – Measuring the preferences in the MAMCA

Qualitative explanation	Corresponding score on the Saaty scale
Measure A is EXTREMELY MORE effective than measure B	9
Measure A is VERY MUCH MORE effective than measure B	7
Measure A is MUCH MORE effective than measure B	5
Measure A is MODERATELY MORE effective than measure B	3
Measure A is EQUALLY as effective than measure B	1
Measure A is MODERATELY LESS effective than measure B	1/3
Measure A is MUCH LESS effective than measure B	1/5
Measure A is VERY MUCH LESS effective than measure B	1/7
Measure A is EXTREMELY MUCH LESS effective than measure B	1/9

Source: Based on Saaty, 2008

The actual survey was conducted between April and May 2009. After receiving an email, the evaluator had to open the Excel sheet and read a brief introduction on the research topic. Next, they were asked to distribute 100 points among the 4 criteria in order to measure their relative importance. Then, each of the 21 participants had to give 24 preferences with the use of pairwise comparisons between 2 of the 4 policy measures, given a specific criterion. The pairwise comparisons were presented in random order, to minimize order effects. Finally, the participants were asked to save the results and send them back by email. Figure 3 illustrates a screenshot of the online survey.

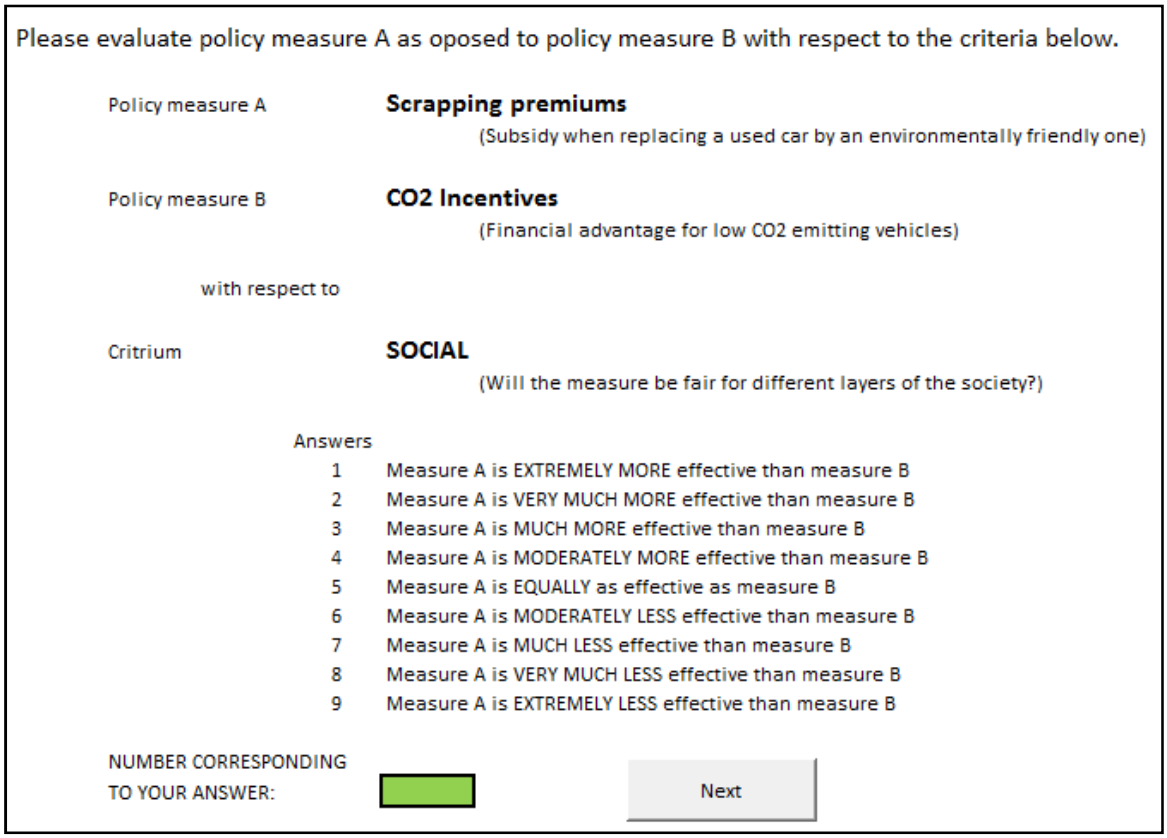

Figure 3 – Screenshot of the online survey

Step 5: Overall analysis and ranking

All analyses were performed in Expert Choice™, a group decision-making software based on the Analytic Hierarchy Process (AHP) method (Expert Choice, 2000). This software takes into account the weights of the criteria and the Saaty scores for every stakeholder. Based on this input, the final results were produced. Graphs clarify which policy measure is preferred by every stakeholder group and how the global weight distribution for the different criteria is set. The software also allows the project manager to analyze the preference of stakeholders separately or to take into account only one criterion.

Step 6: Results of the MAMCA

The MAMCA developed in the previous step leads to a classification of the investigated alternatives. At this stage, a sensitivity analysis can be performed in order to verify if the result changes when the weights are modified. More important than the ranking, the MAMCA allows revealing the critical stakeholders and their criteria. The MAMCA provides a comparison of different strategic alternatives and supports the decision maker in making his or her final decision by pointing out for each stakeholder which alternative is preferred. Figure 4 illustrates the global results from the investigation. On the horizontal axis the 5 stakeholder groups are displayed. As apparent by the rectangular bars, stakeholders are given an equal importance weight. The vertical axis on the right hand side shows the scores of the policy measures and classifies them from most (top) to least (bottom) preferred.

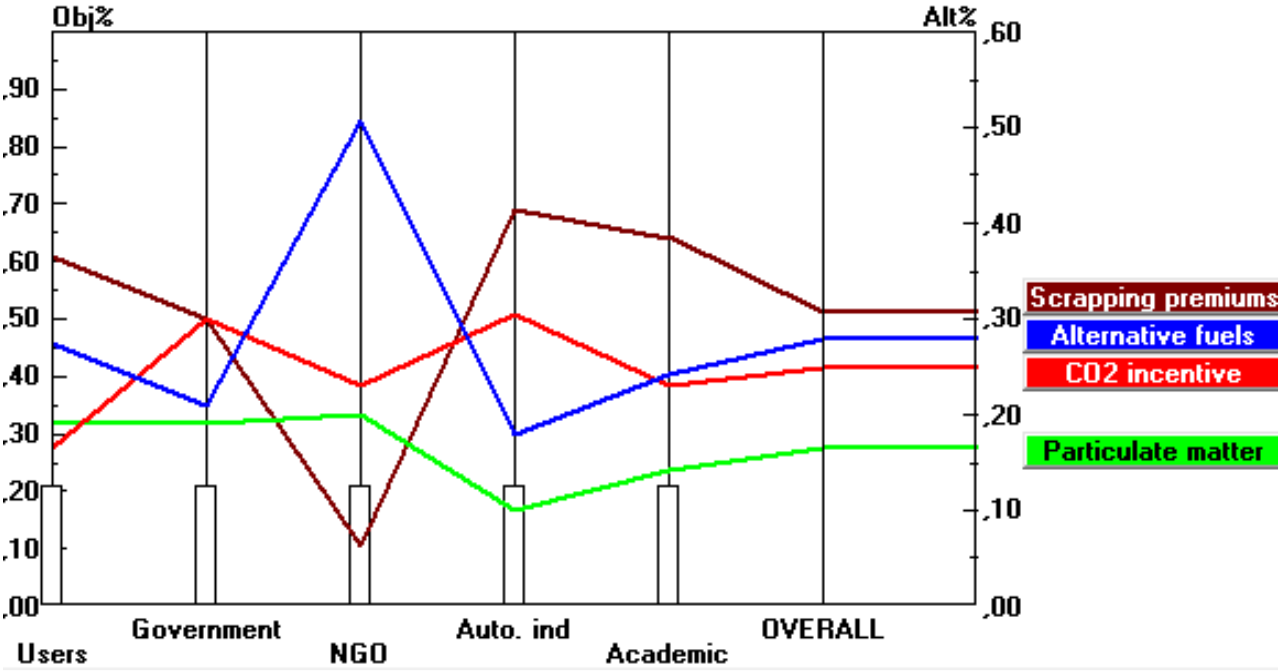

Figure 4 – Global result of the MAMCA

According to the MAMCA, the scrapping premiums (30.7%) are the most preferred policy measure in order to promote environmentally friendly cars. Taken into account the 4 criteria (economy, environment, social and transparency), the stakeholders find that the implementation of scrapping premiums into the car taxation policy would give the best result. When analyzing the value of scrapping premiums for every stakeholder group, we find that for 4 stakeholder groups (users, government, automotive industry and academics), the scrapping premiums are topping the graph. Interesting to see is that for non-governmental organizations, these premiums are ranked as the worst policy measure. When looking deeper into this stakeholder's preferences, it appears that the aversion to the scrapping premiums can not be allocated to an extreme distribution of criteria weights. The scrapping premiums score remarkably low on every criterion for this stakeholder group. Next, the alternative fuel incentive (27.9%) and the CO_2 incentive (24.8%) hold the second and third place, followed by the particulate matter incentive (16.5%).

Figures 5 to 8 illustrate the results for all the criteria separately.

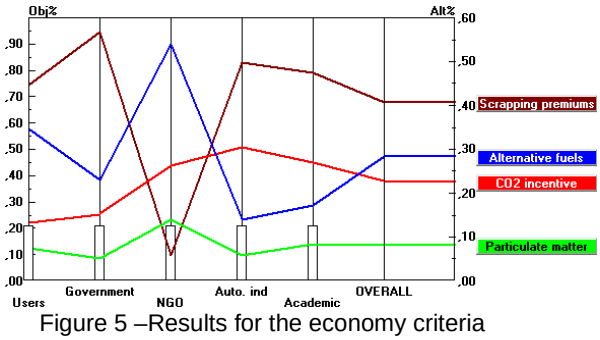

Figure 5 –Results for the economy criteria

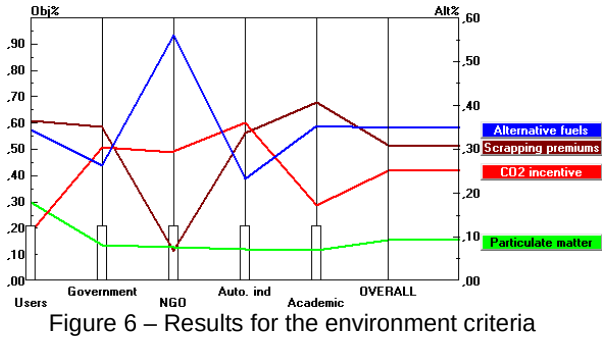

Figure 6 – Results for the environment criteria

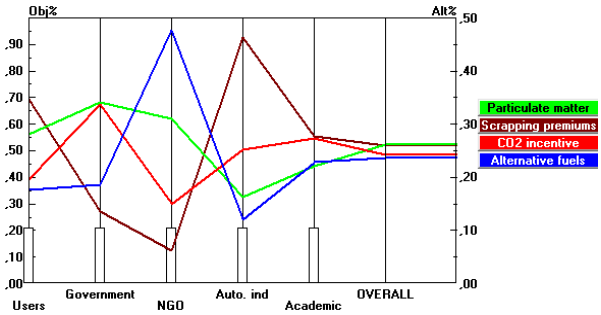

Figure 7 –Results for the social criteria

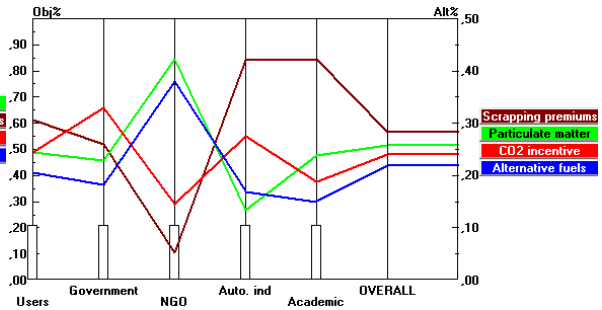

Figure 8 – Results for the transparency criteria

Scrapping premiums are considered to have a positive impact on the economy. This result can be explained by the fact that scrapping premiums are the only policy measure in this research that directly stimulates consumers in replacing their old vehicle, hence boosting the economy. All other policy measures try to shift the preference of consumers towards environmentally friendly vehicles, without actually stimulating the purchase of new vehicles. On the other side, the clean vehicle technology and the CO_2 incentive clearly outscore the PM filter incentive, which is rated the lowest by 4 out of 5 stakeholder groups. The effect on the environment would be optimal if governments financially support the purchase of cars equipped with clean vehicle technology such as hybrids and electric vehicles. Scrapping premiums are rated second, withholding the older and more polluting vehicles from the car

park. Again, the PM filter incentive concludes the ranking. On a social point of view, all 4 incentives are judged to be more or less of equal importance, with a slight advantage to the PM filter measure. Policy makers should pay attention to every income bracket in the society. Finally, the degree of transparency is more or less independent from the actual policy measure, but results of the survey state that the scrapping premiums are subject to the highest level of transparency, as taxation systems could be rather straightforward.
Inconsistency is inherent in the judgment process of the evaluators (Saaty, 1990). When *measure a* is rated twice as good as *measure b*, and *measure b* is rated twice as good as *measure c*, than the only correct answer when comparing *measure a* with *measure c* would be that *measure a* is 4 times as good as *measure c*. In this research, the total inconsistency ratio equals 0.15.

Step 7: Implementation

This is the final step of the MAMCA, after the policy maker has decided on the best alternative. The information on the points of view of each stakeholder, gathered from the previous steps, supports the definition of implementation paths. Possibly new alternatives or modified ones are being proposed for further analysis as more insight into the advantages and disadvantages of a certain alternative for each stakeholder is generated. This creates a feedbackloop towards the beginning of the procedure.

4. DISCUSSION

When examining the results from the stakeholders' point allocation for the evaluation of the criteria, the high score for the environmental criterion could be explained by the potential large impact of the media. The focus in automotive marketing campaigns on television and in newspapers has shifted from performance and luxury to emissions and environmental damage. As a consequence, it seems very probable that there is a general increased importance valuation of environmental aspects by the different stakeholders. This of course benefits the European mission to reach the emission targets. The question remains if people are willing to pay extra if their vehicle pollutes less, which is often not the case (see Potoglou & Kanaroglou, 2006, Carlsson & Johansson-Stenman, 2000, and Friedrich & Bickel, 2001). A possible reason behind the last place of the transparency criterion could be that many evaluators find that the government can make future car taxation as transparent as they like. The level of transparency should not be subject to the tax base or other taxation characteristics.
The global result of this paper contains that scrapping premiums are considered the most preferred policy measure that governments can implement to boost the sale of environmentally friendly vehicles. The preference of the stakeholders in this survey is shared with many European governments, as in less than 9 months after the data collection of Lebeau et al. (2010), 7 new countries agreed on implementing scrapping schemes, making a total of 13 countries (ACEA, 2010). As the surveys were held between April and May 2009,

the evaluators could well have been manipulated by the growing discussions held in many countries whether or not scrapping schemes should be implemented.
Even though the economic outcome of scrapping premiums tends to be positive (+23.2% in Germany, +10.7% in France and +8.8% in Austria) (ACEA, 2010), governments will have difficulties to maintain the financial support given to citizens who replace their polluting vehicle. In a report from GlobalSubsidies (2009), scrapping schemes are considered as a tool to bring the purchase decision of a new vehicle closer in time, hence shifting the decline in sales to a later point in time.
From a methodological point of view, Saaty (1990) claims that an inconsistency ratio of 0.10 or lower is positive evidence for an informed judgment. In this research, the total inconsistency ratio equals 0.15 which would indicate that the stakeholders' judgments are somewhat random or illogical (Kwiesielewicz & Van Uden, 2004). However, this view is not supported by Karapetrovic and Rosenbloom (1999, p. 705) who conclude that "… often the decision maker has not made a mistake. Usually decision makers are quite conscientious in evaluating the pairwise comparisons. The pairwise comparisons that decision makers make are rarely random, even if they fail the consistency test."
Notwithstanding the results of this paper, in which policy measures are evaluated separately, researchers agree that only a combination of fiscal measures can steer the consumer market towards greener cars, as they are complementary strategies (Gordon, 2005).

5. CONCLUSION

Finding a coherent taxation system where consumers are stimulated to buy greener vehicles is definitely one the main issues for policy makers within the upcoming years. Based on information on the incentives for environmentally friendly vehicles in March 2009, this paper evaluates 4 of the most commonly used policy measures in 15 European countries (fiscal premiums for alternative fuels, scrapping premiums, particulate matter incentives and CO_2 bonuses) with the use of the multi-actor multi-criteria analysis (MAMCA) methodology. According to 5 different stakeholder groups (the government, NGOs, automotive experts, academics and users), the most popular policy measure of the last few years, the scrapping premium, is considered the most optimal measure to implement. The included criteria on which the evaluation is based are the economic point of view, the environmental impact, the social justice and the level of transparency.
Future research should increase the number of stakeholders, keeping in mind the possibility to review the results with these evaluators. In addition, investigation should highlight any possible relationship between the contemporary success stories of scrapping premiums in countries such as Germany and the USA, and the frequency of stakeholders responding that this policy measure is optimal to green the car fleet. In the future, research should be devoted to the evaluation of a mix of policy measures and in estimating the effects of these scenarios. Finally, in order to slightly decrease the inconsistency ratio, Saaty (1990) suggests that the pairwise comparisons should be revaluated with the stakeholders.

Acknowledgements
Support for this research was provided by the Department MOSI-Transport & Logistics from the Vrije Universiteit Brussel. The authors would like to express their gratitude to all the people who took the time and effort to fill out the questionnaire.

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