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How environmental goals influence consumer willingness-to-pay for a plastic tax: a discrete-choice analytical study

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Abstract
Damage from petrochemical plastics is not only a problem for the environment, but also for human health. Damage reduction is often based on consumption avoidance by making harmful products more expensive, e.g. through emission taxes for producers. This rather regulates future damage. A consumption-independent tax for citizens, on the other hand, is rare, but could be used to remedy past environmental damage. Whether and how high such a private income tax should be and what regulatory objectives it should pursue was investigated in a quasi-experimental study of 456 German households. The majority of 73%, especially women and younger people, accepted the tax, and this was initially independent of environmental awareness and own plastic avoidance efforts. Only 20% of respondents would initially favour higher taxes to be used for oil-resource preservation, followed by 30% for damage control to humans only, and this was positively associated with environmental awareness. At 37%, most people wanted to remedy damages to human and eco-capital simultaneously, which also generated the maximum tax revenues at 13% rate. Consequently, an effective levy should increasingly consider social factors of the taxed and announce for what revenues are used. This achieves maximum acceptance for better protection of environmental and human capital. The results can guide the design of a future EU plastic tax.

Keywords Corrective tax · Petrochemical plastics · Environmental damage · Internalisation · Resource preservation

Abbreviations

n_{Util}	Proportion of tax supporters for a specific utilisation of tax revenues
n_{Util}^{opt}	Optimal proportion of supporters for a tax yielding maximum revenue for a given utilisation
Π_{Util}	Tax revenues for a given utilisation
Π_{Util}^{opt}	Achievable tax revenues for a given utilisation in the maximisation optimum

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t_{Util}	Tax rate for a given utilisation
t_{Util}^{opt}	Optimal tax rate that generates maximum revenue for a specific utilisation
V_{Age}	Independent variable for the age of the respondent
V_{Att}	Latent variable on personal attitude towards active environmental protection
V_{Avoid}	Latent variable for the respondent's own plastic avoidance efforts
$V_{Consent}$	Response variable for the respondent's consent to a plastic tax
V_{Damage}	Variable on how to continue with the damage caused by plastic consumption
V_{Edu}	Independent variable on the highest educational qualification of the respondent
V_{Gend}	Independent variable for the gender of the respondent
V_{Home}	Independent variable for the household size of the respondent
V_{Human}	Tax is used for damage regulation on the asset "human capital"
$V_{+Nature}$	Tax is additionally used for damage regulation on the asset "nature capital"
V_{Util}	Variable describing the asset for which the tax revenue is utilised
$V_{Profess}$	Independent variable for the employment status of the respondent
V_{Source}	Tax is utilised to preserve oil-resources as a result of substitution with biopolymers
V_{Tax}	Variable for the tax rate accepted by respondents

1 Introduction

The global amount of fossil plastics was 368 million tonnes in 2019 (Statista, 2020). Of the 58 million tonnes in Europe, only 30% is recycled, the rest is incinerated or landfilled (Parliament of Europe, 2019). The production of plastics consumes finite resources and produces harmful greenhouse gases (Scherer et al., 2018). Disposal is accompanied by the release of microplastics into the environment (Heidbreder et al., 2019). Costs for damage regulation are usually covered by society, whereas internalisation instruments are directed at producers (Evans et al., 2017). Besides bans, restrictions or taxation, the use of sustainable technologies can reduce some damage. These include bioplastics from renewable resources which preserve oil-reservoirs and impact the environment less (Klein et al., 2019). However, at 2.11 million tonnes worldwide, their share is rather low (Buschmann & Freund, 2019).

To date, alternative materials insufficiently replace petroplastics. Nevertheless, regulators could take appropriate measures to reduce environmental damage on public goods. The state often bears the remedial costs through governmental income. In this context, studies usually examine the effect of a Pigouvian tax on companies. It reduces harmful output quantities as a result of increased production costs (Säll & Gren, 2015). In contrast, only few studies address the effect of an environmental tax on consumers. In such investigations, a tax is imposed on the current consumption of harmful goods and therefore tends to regulate future damage. However, it is actually apparent that the damage caused by past consumption also urgently needs to be resolved, for which today's consumers are likewise jointly responsible. This could be settled through a solidarity levy, as existed in Germany after reunification in 1991 and served for the development of Eastern parts. Since this form of levy is not offset by any actual consumption, high acceptance is necessary, for which a pronounced environmental awareness might be indispensable. The effect of a consumption-independent tax would be twofold. If income is reduced, consumption is also lower and this avoids future damage due to fewer purchases. On the other hand, the government can spend tax revenues to regulate damage in a more targeted way. Park et al. (2017) derived

from the sustainable attitude of consumers a significant willingness-to-pay (WTP) for eco-taxation. However, the authors also found that acceptance depends on what exactly the tax money is used for. For Mathieu-Bolh (2017), it also plays a fundamental role, whether the purchased good or the later air pollution after disposal is taxed. However, Khastar et al. (2020) raise concerns about too high taxes, which immiserates welfare of consumption-intensive economies.

It is obvious that tax revenues can finance a large number of different damage prevention and remediation measures. The question is rather their prioritisation for maximum success. Regardless of the opinion of environmental experts, however, the focus must also be accepted by taxpayers. There are many new technologies, like photocatalytic composites which use sunlight to clean contaminated waters (Zinatloo-Ajabshir et al., 2021a; Zinatloo-Ajabshir et al., 2021b; Zinatloo-Ajabshir et al., 2021c; Beshkar et al., 2015). Other technologies aim more at avoiding petroleum depletion, e.g. by keeping PET bottles longer in applications. Particularly in regions with inadequate recycling processes, they can be incorporated into masonry construction for optimising thermal insulation, or they serve as additive powders in polymeric concrete (Bachtiar et al., 2020; Dadzie et al., 2020).

The list of potential measures is long, and a plastic tax is already under discussion in Europe. Clarifying certain issues in advance help developing a particularly innovative, and at the same time effective, tax system to solve the most urgent problems. Basic research gaps in this context are: (1) Does it make sense to involve taxpayers in the design of a tax model? (2) Does it make a difference in acceptance if taxpayers are precisely informed about the use of tax revenues? (3) Are avoidance or remedial measures more urgent in the eyes of consumers? (4) In the latter case, do consumers see a direct damage potential to health or rather indirectly from environmental harms through plastic consumption?

From a theoretical point of view, the answers allow for more realistic and empirically proven assumptions about damage perception and WTP in future model analyses. However, how to practically design the tax, is still open. To find answers, this study investigates the following research questions: (1) Do private consumers agree with a consumption-independent levy to participate financially in the regulation of damage from petroplastics, and on which personal criteria does their consent depend? (2) What would then be the average accepted plastic tax on income, and which factors increase their WTP? (3) Would consumers first invest preventively in oil-resource preservation, or directly want to pay for damage? (4) What is the maximum achievable rate depending on different utilisations of tax revenues?

The remainder of this paper is as follows: at first, a review derives appropriate variables from the literature to address the research questions and formulates concrete hypotheses. The precedent section introduces the empirical method of data generation and analysis techniques. Then, the results are presented, and in the following section, findings are discussed in the light of current literature. The last section concludes and addresses limitations and further research needed.

2 Literature review

2.1 Damage regulation through taxation

2.1.1 Social factors influencing damage assessment

Shao et al. (2018) found a concave relationship between damage evaluation and a person's welfare, showing a maximum at middle income. The social environment also seems to be an influencing factor, as residents of highly polluted areas revealed more WTP for greener products. This might reinforce acceptance of higher eco-taxes. A correlation with income was also found by Mantovani et al. (2017), whereby consent to more expensive green products decreased with lower salaries, particularly for competitive goods. Since income influences WTP, the present study reveals if agreement of privates with participating in regulation depends on this aspect.

Other factors were investigated by Klaiman et al. (2016), who report that age and household size significantly affect pro-environmental attitude, but gender and family status do not. This contradicts Martinho et al. (2015), who concluded that gender likewise influenced environmentally friendly action. Shiel et al. (2020) investigated whether damage assessments also take into account disadvantages for future generations. They found that such consideration correlated with household size and gender, but not with age. Regarding personal traits, household size (V_{Home}), professional status (V_{Profess}), educational level (V_{Edu}), gender (V_{Gend}) and age (V_{Age}) are likewise part of the study.

2.1.2 Latent factors influencing damage assessment

In addition to social factors, personal attitudes may also influence the consent to a plastic tax. Wu and Yang (2018), for example, show that people act more sustainably as their moral conscience grows. However, according to Ali et al. (2020), the will to act decreases with increasing external pressure. Therefore, the authors recommend that policy-makers should stimulate intrinsic motivation with incentives, instead of demanding environmental action as a compulsory contribution. In the present study, this could lead to rejection of a plastic tax, even if there are strong feelings for sustainability. In contrast, Kautish et al. (2019) found a correlation between environmental attitudes and active recycling behaviour. In a study by Van et al. (2021), however, active plastic avoidance efforts by Malaysian consumers were not triggered by their environmental awareness. Hence, the present study clarifies if there is consent to a plastic tax at all, and if this is dependent on own plastic avoidance efforts and environmental conscience. Huang et al. (2014) showed that such attitude-relevant variables are additionally associated with socio-demographic factors, whereby younger people and women were more environmentally aware. To additionally measure the potential influence of personal attitudes towards environmental damage and active plastic avoidance commitment, the latent variables "environmental awareness" (V_{Att}) and "plastic avoidance efforts" (V_{Avoid}) are used in the study as well.

2.1.3 Effectiveness of environmental taxation for damage regulation

Environmental damage can be reduced by restricting or taxing pollution activities. According to Karp and Zhang (2016), the stronger damage increases with harmful output, the

higher tax rates should be. For De Weerdt et al. (2020), an eco-tax is already proposed in some European countries, and Walker et al. (2020) report that the European Union even prepares a harmonised plastic taxation. Bioplastics might get more popular, because consumers will demand greener materials then (Orset et al., 2017).

In research and in practice, taxation of polluting activities is mostly directed at producers. Studies on consumer willingness to participate in environmental damage regulation are comparatively rare. In this context, Mathieu-Bolh (2017) expects a double dividend from taxation, because thinking will also change through payments. At the same time, surpluses from taxation may be paid back to reward people. For the authors, however, it makes a difference whether the environmental tax relates to the purchase of dirty products or to environmental damage that has already occurred. According to Khastar et al. (2020), the first dividend is obvious in its effect, because in Finland, a carbon tax already provoked a significant decline in consumption. However, social welfare, as second dividend, decreased simultaneously. Apparently, the tax rate is crucial when polluters are charged. Hence, for an effective tax on damage that has already occurred, Lian et al. (2018) recommend a lower rate under participation of more payers. But if the tax relates to future damage, then rates should be higher and affect fewer payers. The latter scenario applies more to companies and makes effective regulation independent from consumers. Nevertheless, it might be that also privates feel obliged to participate in the regulation of environmental damage, maybe through renouncing on income. In a study by Park et al. (2017), Chinese respondents accepted higher rates if they were told, for what the tax revenue was used. In research by Fairbrother (2019), English people were asked to pay tax for environmental protection, but once they knew that fuel and energy should be levied, acceptance significantly decreased. Nguyen et al. (2016) also see price increases of dirty products as an ideal internalisation method, achieved by corrective taxes, and this then makes more expensive green products competitive. But obviously, consumers are not always in favour of this. Therefore, the current study uses income as the basis for taxation, which is independent of specific products. For this purpose, a variable V_{Consent} is introduced which measures agreement with the tax burden, and the first hypothesis is:

H1 A majority of private consumers are willing to give up part of their income to participate in environmental damage regulation.

To make such willingness measurable, the study applies several tax rates, because all income groups might perceive this as similarly burdensome. Irrespective of the individual resource endowment, also other factors could explain why such taxation is rejected. In this regard, Gill and Moeller (2018) found that small households feel less burdened by an energy tax, when they live in cities. In contrast, for large families with own homes in the countryside, this taxation is more serious because they consume more energy. For Mathieu-Bolh (2017), the second dividend from an environmental tax is differently effective, depending on the payer's age. Obviously, latent factors play a major role, particularly in a study on private plastics taxation. Since no study so far revealed if consent to such taxation depends on environmental commitment (V_{Att}) and plastics avoidance efforts (V_{Avoid}), a next hypothesis is put forth:

H2 Consent with taxing one's own income for environmental damage regulation depends on socio-demographic factors or personal attitudes towards environmental protection and plastic avoidance.

Whether contextual factors also influence the individually accepted maximum tax rate is tested by another hypothesis:

H3 The level of the individually accepted maximum tax rate depends on socio-demographic factors or personal attitudes towards environmental protection and plastic avoidance efforts.

2.2 Spending of tax revenues

2.2.1 Plastics substitution technologies for oil-resource preservation

For Keller et al. (2020), substituting petroplastics with biopolymers makes the industry more sustainable. However, the high biomass demand could lead to over-acidification of cultivated areas. Nevertheless, Belboom and Léonard (2016) estimate the greenhouse gas reduction potential of bio-polyethylene with up to 60%, although their production still consumes energy from fossil resources. To optimise this, Papageorgiou (2018) suggests replacing part of energy-intensive biopolymers with plant fibres, resulting in natural fibre–plastics composites. But already in blending petroplastics with biopolymers, the authors see a noticeable reduction in CO_2 emissions. A new research direction called composite-polymer analytics (compolytics) investigates, how such green plastic composites can make many applications more ecological (Friedrich, 2018). Furthermore, Alay et al. (2016) emphasise the easier disposal of biobased materials. For Hottle et al. (2017), this can be composting, although their recycling should always remain privileged. Erickson et al. (2018) follow a different approach and demand a stop of fossil-resource depletion through withdrawing oil-drilling permits. In the present study, a variable V_{Util} specifies the asset, which should be protected by tax payments. In this context, V_{Source} concerns oil-reservoirs, and it takes the values 0 for "no preservation", i.e. ongoing extraction for plastics production. The value 1 denotes a 50%-preservation (Source 1/2), achieved by blending of petroplastics half with biopolymers. Finally, completely preserving fossil resources requires a 100% bioplastics use (Source 1), which is represented by the value 2. The following hypothesis is formulated:

H4 Taxpayers want to use their contribution to preserve oil-resources rather than to pay for damage that has already occurred.

2.2.2 Damage prevention to human resources and eco-capital

Humans could take up microplastics from food as consequence from ecosystem contamination (Waring et al., 2018). Nanoparticles are considered dangerous because they accumulate in the brain, liver and tissue. According to Wright and Kelly (2017), this then leads to chronic symptoms of intoxication with corresponding immune reactions of the body. Hwang et al. (2019) refer to symptoms like haemolysis, hypersensitivities and cytotoxicity. For Prata et al. (2020), also dermatological absorption, maybe through synthetic clothing, is crucial. When testing consumer WTP for plastic taxation, the subjectively perceived hazard potential from petroplastics might play a role. Hence, the next asset is human capital (V_{Human}). To express the degree of protection, variable V_{Damage} takes the value 0 for the current harm level not to increase any further, and 1 for a level that should be reduced to zero.

There is no doubt that petroplastics primarily pollute ecosystems and indirectly humans through food chains. Gorence et al. (2019) deduced from experiments with mice that animals absorb harmful substances from plastics. If these were kept in plastics cages, they showed higher concentrations of bisphenol-A. According to Beaumont et al. (2019), degradation of plastics is also dangerous for aquatic environments, and this harms fishes and even more endangered species and rare nature sites. In addition to local and regional threats, air pollution is omnipresent in the global ecosystem. Verma et al. (2016) refer to the climate-changing effect from PVC combustion and release of halogenates with long-term consequences for next generations. Therefore, the third asset counts nature-biosphere to human capital and is represented by $V_{+\text{Nature}}$. Here, V_{Damage} takes on 0, if tax revenues should simultaneously be invested in environmental measures to keep the current damage constant, or damages should be reduced to zero (=1).

The will to co-finance damage regulation from plastics consumption depends also on situational factors. In this context, Rajapaksa et al. (2017) and Wagner et al. (2021) found an influence from experienced environmental disasters on the own ecological commitment. This effect can even be stronger than the perceived social norm, i.e. when others demand a sustainable action (Dasgupta et al., 2016). The previous section already showed that such external stimuli from third parties might weaken intrinsic motivation, which Huang et al. (2014) also revealed for monetary extrinsic incentives. Since the present study requires the opposite, i.e. financial sacrifices, extremely environmentally conscious consumers would even more agree with particularly high tax burdens, which H3 already proves. Nevertheless, the studies cited leave open what the true motivation for such action is. The findings of Birch et al. (2018), who explain consumers' preference for local products with self-interested motives, bring some clarity. Buerke et al. (2017) distinguish between one's own responsibility towards the society and oneself. The latter is pronounced if environmentally friendly action is primarily intended to protect the own health (V_{Human}). Similar to an experienced environmental disaster, this could be the case if consumers are themselves burdened with health problems, and they strive in environmental protection for their own well-being. In the present study, highly environmentally aware taxpayers would therefore be more inclined to use their tax revenues for reducing damage primarily to human capital (V_{Human}) than additionally to nature ($V_{+\text{Nature}}$). This is clarified as follows:

H5 When it comes to damage repair, taxpayers prefer their taxes to be used primarily for human capital rather than to spend it for nature repair also, and this is influenced by their attitude.

2.3 Optimal tax rate and achievable revenue

H4 and H5 examine the differences in consent to tax rates and depending on the assets, in which revenues are invested. Concerning tax utilisation, Säll and Gren (2015) investigated an environmental tax on meat imposed to Swedish consumers. As a result, the authors recommend a tax rate of 8.9–33.3%, which is a high range. Certainly, environmental damage from animal farming can be estimated comparatively more accurately than from plastics consumption. The importance of reliable data was already pointed out by Karp and Zhang (2016), as the slope of the marginal damage cost curve determines the efficient tax rate. To date, the literature quantified environmental damage from plastics only indirectly for particular issues. For example, Beaumont et al. (2019) assessed the costs of cleaning oceans at $3300–$33,000 per tonne of plastics, which is vague

and leaves open total quantities. To reactivate CO_2-absorption of Brazilian rainforest, Pavanelli and Voulvoulis (2019) calculated reforestation with $32,692–$139,389 per hectare, which again is a wide range. It is almost impossible to derive concrete damage values from the literature. Therefore, the study determines the damage potential from plastics indirectly from consumers' consent to different tax rates on their income. This is then based on the sum of all knowledge and emotional involvement of respondents, which represent the entire population. Although this might be as vague as the cited literature, it nevertheless paints a realistic picture of expected tax revenues. In this context, it is then interesting to see through which asset-related preference order maximal tax rates can be achieved. Therefore, a variable V_{Tax} measures tax preferences in 5%-steps up to 25%. Hence, the next hypothesis tests:

H6 If tax revenues are initially used to protect "human capital" only, or additionally for "nature capital", then more taxpayers opt for the maximum rate as if oil-resource preservation is initially favoured.

However, a maximum rate at 25% might only be supported by a minority of the population. For practical reasons, alone the tax rate, which generates maximal revenues, is of interest. Since H6 already assumes a dependence of consent on utilisation, this should then also apply to the maximal tax revenue. Therefore, the last hypothesis is:

H7 The highest achievable tax revenues differ in terms of tax utilisation.

Figure 1 illustrates the study framework and gives an overview of test variables and hypotheses.

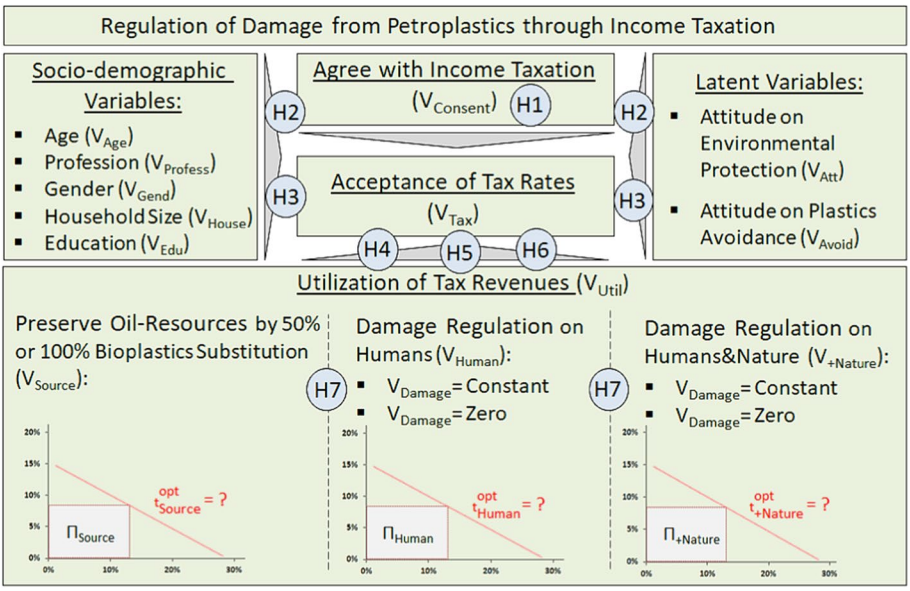

Fig. 1 Study framework with test variables and hypotheses

3 Method and analyses

3.1 Data generation through consumer survey

The study is survey-based and was conducted by students of the Cooperative State University in Mosbach, Germany, between January and April 2021. Each student had to interview at least 15 consumers from their social network with as heterogeneous characteristics as possible and from different households.

The data generation follows an inductive method using a questionnaire as an attribute-based choice experiment to introduce different taxation regimes to respondents (Appendix). Query Block 1 (Fig. 2) contained a 16 choice-set structure, each comprising only 2–3 attribute settings as stimulus to avoid fatigue effects. The combinations resulted in a 3 (V_{Source})×2 (V_{Human})×2 ($V_{+\text{Nature}}$)×5 (V_{Tax}) between-subject orthogonal design. Of the 60 sets, 32 were blocked if, for example, a higher tax rate was associated with less resource preservation under constant, rather than decreasing, damage potential. All attributes entered the quota plan as effects coded variables, to which one opt-out item per set was added. The 16 sets were arranged in order of increasing total utility. Set 1 started with a "Standard Regime" with no resource preservation (coding: $V_{\text{Source}}=0$), use of revenues for asset "human capital" only ($V_{\text{Util}}=0$) under constant damage ($V_{\text{Damage}}=0$). This moderate regulation target costs the taxpayer 5% of income ($V_{\text{Tax}}=0$). For a 10% rate, as next choice-set, either the damage to human capital could be reduced to zero ($V_{\text{Damage}}=1$), or nature could be additionally regulated ($V_{\text{Util}}=1$), while $V_{\text{Damage}}=0$ still applied, hence remaining constant. Depending on the preference, one was then forwarded to a specific set, which suggested a bundle of higher usefulness, but then also at higher tax rate. If none of these options found approval, this set again contained the previous preference as alternative, which as opt-out function led over to the social query (Fig. 2: Block 2).

Block 1 thus resembled an experimental auction, as also applied by Vecchio and Annunziata (2015). It follows the principle of Multi-Criteria Decision Making (MCDM), where a choice is always made among multiple attributes (Pohekar & Ramachandran, 2004). However, the respondent can see which bundle provides the minimum or maximum utility, which follows the Boundary Value Principle (Rao &

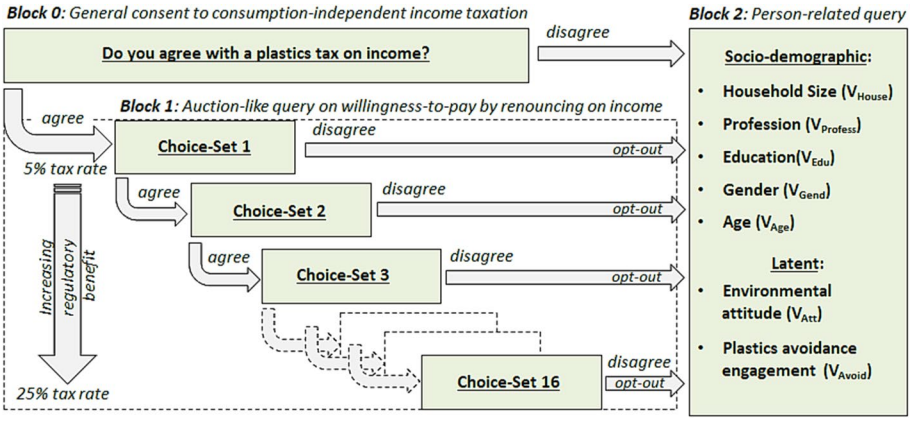

Fig. 2 Questionnaire structure and query approach

Patel, 2010). By arranging the sets with increasing total utility, the preference order results from a multi-stage decision problem, in which the choice is always made as pairwise comparison and finally ends in a decision hierarchy (Wong & Li, 2008). Simultaneously, the number of supporters decreases with increasing self-taxation (Xu et al., 2016). This is because the income budget gets tighter, and the 5% tax surcharge is offset by an increasingly lower additional utility.

After selecting an opt-out, but at the latest after the 16th choice-set with 25% tax burden, the psychometric and socio-demographic quotas, as per Fig. 1, are queried in Block 2 (Fig. 2). Here, attitudes towards the need for low, medium or high active environmental protection (V_{Att}) are measured. And also one's own commitment to plastic avoidance (V_{Avoid}) could be indicated as little, medium and much. The questionnaire started with a textual and visual description of the problems from plastics. Taxation on income was introduced as regulatory instrument, and information on bioplastics for substituting oil-consumption was provided. Other revenue utilisations, as the development of new technologies for damage limitation or repair on humans and nature, were explained. Afterwards, Block 0 with V_{Consent} asked, whether respondents favoured a participatory and equally burdensome regulation by tax, which in case of approval directed them to the 16 choice-sets. Alternatively, participants could disagree and opt for an individual handling of the plastics problem, on which socio-demographic quotas followed immediately.

3.2 Analyses and visualisation of results

Once the data sets were obtained from the quotas, the representativeness of respondents was first checked by comparing them with the official demographic statistics (Destatis, 2020). Afterwards, quotas were used to clarify the hypotheses, mostly by means of descriptive statistics using SPSS. The test conditions are summarised in Fig. 3, according to which H1 could be confirmed, if V_{Consent} indicates a majority of tax supporters. For clarifying which variables distinguish both groups, the dichotomised and grouped data from V_{Consent} were compared with the coded results from the total of 7 quota variables of Block 2 (Fig. 2). If the ANOVA-test revealed a difference at 5% level, H2 was maintained according to Fig. 3. To prove H3 on the level of accepted tax rates, all selected opt-outs were first counted on each V_{Tax} level from Block 1. The maximum was then determined from a histogram and its skewness assessed. Whether quotas from Block 2 had a measurable effect on the maximal tax rate, was clarified by the correlation matrix with V_{Tax}. For significant intersections, the effect size was calculated using chi-square test and Pearson's r-value for up to 5% significant correlations. In addition, the goodness-of-fit was tested by means of RMSEA-value and the condition $1 \leq \chi^2/\text{df} \leq 3$, likewise applied by Koenig-Lewis et al. (2014). In case of unmeasurable or insignificant correlation, H3 was rejected according to Fig. 3.

To clarify the remaining hypotheses, the results were first presented as decision tree with three main paths per V_{Util} (Fig. 1), which were numbered according to the choice-sets. To these paths, the quantity of respondents agreeing with the respective tax level was assigned. At 10%-level, one could either invest the first 5% tax increase preventively in oil-resource preservation (V_{Source}), or keeping damage regulation for humans only (V_{Human}), or also spending for nature capital ($V_{+\text{Nature}}$). These three main paths are subdivided by the follow-up preferences, i.e. whether after resource preservation one would then further invest only in human assets or also in nature capital, while keeping damages constant or set to zero. This translated into 14 sub-paths.

H1: *Plastics tax supported by majority of n consumers.*
→ If $n^{disagree}(V_{Consenti}) > n^{agree}(V_{Consenti})$, then reject

H2: *Tax deniers and supporters differ in socio-demographic or latent variables.*
→ If $n^{Tax}_{agree} \neq n^{Tax}_{disagree}$ for V{Age;Profess;Gender;House;Edu;Att;Avoid}, then reject

H3: *The accepted tax rate (V_{Tax}) depends on socio-demographic or latent variables.*
→ If $r^{correl}(V_{Tax} \mid V\{Age;Profess;Gender;House;Edu;Att;Avoid\}) < 0.1$
or not [1…χ^2/df…3 or RMSEA≤0.08], then reject

H4: *Most taxpayers initially opt for oil-resource preservation measures rather than human and/or nature damage repair.*
→ If $n^{agree}(V_{Tax}=10\%) \in \{Path1,5 \text{ and } 1,6:Tax^{Util}_{Source}\} < \begin{cases} n^{agree}(V_{Tax}=10\%) \in \{Path2:Tax^{Util}_{Human}\} \\ \text{or: } n^{agree}(V_{Tax}=10\%) \in \{Path3:Tax^{Util}_{+Nature}\} \end{cases}$
, then reject

H5: *If taxpayers do not initially opt for oil-resource preservation, they then do so to regulate human damage rather than additionally pay for environmental damage. This then depends on latent variables.*
→ If $n^{agree}(V_{Tax}=10\%) \in \{Path2:Tax^{Util}_{Human}\} < n^{agree}(V_{Tax}=10\%) \in \{Path3:Tax^{Util}_{+Nature}\}$
and $r^{correl}(V_{Human} \mid V\{Att;Avoid\}) \neq r^{correl}(V_{+Nature} \mid V\{Att;Avoid\})$
for $r^{correl} < 0.1$ or not [1…χ^2/df…3 or RMSEA≤0.08], then reject

H6: *More taxpayers accept the maximum tax rate for damage regulation to humans or humans&nature than for oil-resource preservation.*
→ If $n^{agree}(V_{Tax}=25\%) \in \{Path1,5 \text{ or } 1,6:Tax^{Util}_{Source}\} > \begin{cases} n^{agree}(V_{Tax}=25\%) \in \{Path2:Tax^{Util}_{Human}\} \\ \text{or: } n^{agree}(V_{Tax}=25\%) \in \{Path3:Tax^{Util}_{+Nature}\} \end{cases}$
, then reject

H7: *The maximum achievable tax revenues according to the number of supporters and their accepted tax rates vary depending on what the tax revenues are used for.*
→ If not $max.\Pi_{source} \neq max.\Pi_{Human} \neq max.\Pi_{+Nature}$, then reject

Fig. 3 Conditions for clarifying the hypotheses (information on the paths, e.g. Path 1,5, according to the Appendix, Block 1)

According to Fig. 3, H4 is already rejected, if, on the 10%-level, the number of $V_{\text{Human}}-$ or $V_{+\text{Nature}}-$ supporters exceeded the votes for V_{Source}, which indicates that damage occurrence matters more than its prevention. It was additionally investigated, how many respondents after 50% resource preservation ($V_{\text{Source}}=1$) still completed to 100% ($V_{\text{Source}}=2$), or furtherly invested in human health only, or additionally in eco-capital. Similarly, it was researched whether, after an initial choice of the latter two, people then at all preferred to continue with V_{Source}, instead of opting for further harm reduction. According to Fig. 3, H5 is rejected if more people chose V_{Human} than $V_{+\text{Nature}}$ on 10%-level. To understand the motivations, the two groups were coded and crossed with the latent variables from Block 2. In case of $r \geq 0.10$ ($p \leq 0.05$), this decision on V_{Util} is influenced by V_{Att} and/or V_{Avoid}.

As next, the number of approvals at the highest tax level of 25% was compared between all 14 sub-paths. If the maximum values are in the main path for V_{Human} or $V_{+\text{Nature}}$, H6 is maintained according to Fig. 3. A closer inspection of the related sub-paths explains which preference order most often leads to the highest accepted tax rate. Finally, Fig. 3 demands for rejection of H7 equal revenues for all three regulation targets. For this, the tax rates for each main path were plotted against the number of supporters, and the graphs were represented algebraically and graphically by means of regression curves. The maximally

achievable tax revenue Π per V_{Util} could be derived from the inscribed rectangle of maximal area (Fig. 1). For oil-source preservation, the revenue is:

$$\Pi_{\text{Source}} = t_{\text{Source}} \cdot n_{\text{Source}} \tag{1}$$

with Π_{Source} as the achievable tax revenue, t_{Source} as the tax rate supported by n_{Source} respondents. The same applies to the assets "Human" and "+Nature".

To find out which t_{Util} makes Π_{Source} maximal, the first-order condition of the differentiated Eq. (1) is solved:

$$\frac{\partial \Pi_{\text{Source}}}{\partial n_{\text{Source}}} = 0 \rightarrow n^{\text{opt}}_{\text{Source}} \tag{2}$$

with $n^{\text{opt}}_{\text{Source}}$ as the revenue-maximal number of supporters at a corresponding rate. Equation (2) likewise applies to both other assets. If $\Pi^{\text{opt}}_{\text{Source}} \neq \Pi^{\text{opt}}_{\text{Human}} \neq \Pi^{\text{opt}}_{+\text{ Nature}}$, H7 is confirmed (Fig. 3).

4 Results

4.1 Representativeness of respondents

A total of 456 private consumers were interviewed. Table 1 shows that the students rather contacted their peers, because there are more younger representatives (55.3%) than in the demographic statistics (30.1%). Nevertheless, the middle age is well represented (24.4%). Younger people preferentially lived with parents, which is why more family households were involved (42.9%). The number of employed persons (46.6%) reveals that the majority is already working and has own income. This is also supported by the result on educational qualification (V_{Edu}), as three quarters of all respondents already held a job-qualifying degree. Even if the data do not correspond exactly to those of the official demographic statistics (Destatis), all population groups are represented in sufficient quantity. The two latent variables reveal that the majority is open to environmental measures (V_{Att}), but in comparison, fewer are willing to actively avoid plastics (V_{Avoid}).

4.2 Consent to income-based plastic tax and reasons

Table 2 shows that the majority of 72.8% (332 respondents), agreed with taxing their income. This confirms H1 (Fig. 3). The difference test reveals that both groups have the same attitude towards active environmental protection (V_{Att}) and also equally support the avoidance of plastics in daily life (V_{Avoid}). Thus, the reasons for rejection are not latent in personal attitudes towards the topic. The difference test on socio-demographic variables was specific for gender (V_{Gend}), according to which more women were among the supporters. This confirms H2 (Fig. 3).

4.3 Taxation rates and motivations

Table 3 shows for each tax level the proportion of those who rejected any further tax increase, hence chose "opt-out" as next choice. As can be seen, the peak is at $t = 15\%$, still approved by 31% of tax supporters. The histogram is skewed towards higher rates.

Table 1 Results on socio-demographic variables from 456 respondents

Variable:	Survey result [%]:	Destatis, 2020 [%]:	Variable:	Survey result [%]:	Destatis, 2020 [%]:	Variable:	Survey result [%]:
V_{Age}:			V_{Home}:			V_{Att}:	
< 30 $_{(=0)}$	55.3	30.1	Single $_{(=0)}$	29.7	42.3	Low $_{(=0)}$	31.7
30…50 $_{(=1)}$	24.4	25.2	Couple $_{(=1)}$	27.5	33.2	Average $_{(=1)}$	55.7
> 50 $_{(=2)}$	20.3	44.7	Family $_{(=2)}$	42.9	24.5	High $_{(=2)}$	12.6
V_{Gend}:			$V_{Profess}$:			V_{Avoid}:	
Female $_{(=0)}$	46.9	50.7	Student $_{(=0)}$	45.0	15.1	Low $_{(=0)}$	48.7
Male $_{(=1)}$	53.1	49.3	Employed $_{(=1)}$	46.6	53.6	Average $_{(=1)}$	44.2
V_{Edu}:			Retired $_{(=2)}$	2.7	9.0	High $_{(=2)}$	7.1
School $_{(=0)}$	25.4						
Commercial $_{(=1)}$	42.3						
Academic $_{(=2)}$	32.3						

Destatis = Federal statistical office

Table 2 Consent to private plastic taxation and differentiating factors

Statistics:	Tax deniers ($V_{Consent}=0$):	Tax supporters ($V_{Consent}=1$):
Descriptive:	27.2% (124 entries)	72.8% (332 entries)
Hypothesis:	72.8 > 27.2: H1 maintained	
Difference test:	V_{Att}	$F(454,1)=0.10$; $p=0.914$
	V_{Avoid}	$F(451,1)=0.19$; $p=0.660$
	V_{Gend}	$F(439,1)=5.45$; $p=0.020$
Hypothesis:	$p_{Gend} \leq 0.05$: H2 maintained	

Table 3 Highest still acceptable tax rates, their share of supporters and influencing factors

Statistics:	Tax supporters ($V_{Consent}=1$):	
	Tax rate t [%]: $_{(coded)}$	Share of supporters [%]:
Descriptive:	05.0 $_{(=0)}$	13.0
	10.0 $_{(=1)}$	20.4
	15.0 $_{(=2)}$	**31.0**
	20.0 $_{(=3)}$	22.9
	25.0 $_{(=4)}$	12.7
Effect size:	V_{Att}	$\chi^2=25.36$; $p=0.001$; df = 8; $r=0.22$; $\chi^2/df=3.2$; RMSEA = 0.08
	V_{Avoid}	$\chi^2=32.08$; $p=0.001$; df = 8; $r=0.27$; $\chi^2/df=4.0$; RMSEA = 0.10
	V_{Gend}	$\chi^2=3.92$; $p=0.053$; df = 4; $r=-0.11$; $\chi^2/df=1.0$; RMSEA = 0.01
	V_{Age}	$\chi^2=30.24$; $p=0.002$; df = 16; $r=-0.18$; $\chi^2/df=1.9$; RMSEA = 0.05
Hypothesis:	$p \leq 0.05$ and $r \geq 0.10$: H3 maintained	

According to Table 3, the attitude towards environmental protection had significantly weak influence, with more environmentally active persons accepting higher rates. This has almost good predictive quality. The same applies to those who more actively avoid plastics, but with less forecast quality. Thus, environmental attitude is the better indicator for predicting accepted plastic tax rates. It also appears that women ($r=-0.11$) and younger people ($r=-0.18$) favour higher taxes more, both with good predictive quality. Since latent and social variables were significant, H3 is even more maintained according to Fig. 3.

4.4 Preferential use of tax revenues

Figures 4 and 5 illustrate the decision tree from the counted entries. Figure 4 indicates that 42 tax supporters immediately chose an "opt-out". Hence, they tolerated the "Standard Regime" and only damage to human capital should not increase any further, which they supported with 5% of their income. Figure 4 also contains the main path for "Source", i.e. all votes for a 10%-rate, that would initially be used for 50% oil-resource preservation. As can be seen, of the 332 supporters, 64 (19.28%; Path 1,5 and 1,6) opt for financing a 50%-blending of petroplastics with biopolymers. After that, only 2.71% + 0.60% = 3.31% (Path 1,6 and Path 1,5,21) chose "Source (1)", hence using 100% bioplastics. In

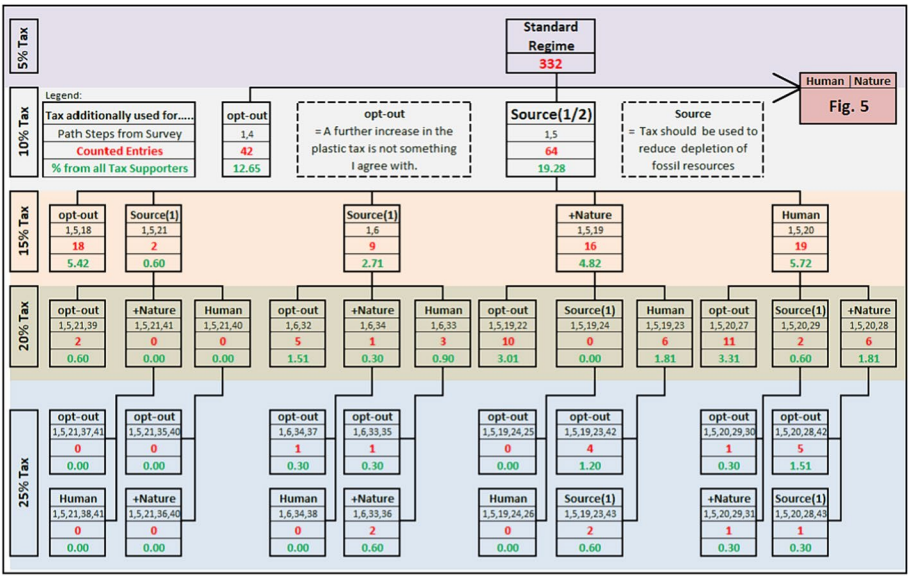

Fig. 4 Decision tree for the primary utilisation of tax revenues for oil-resource preservation

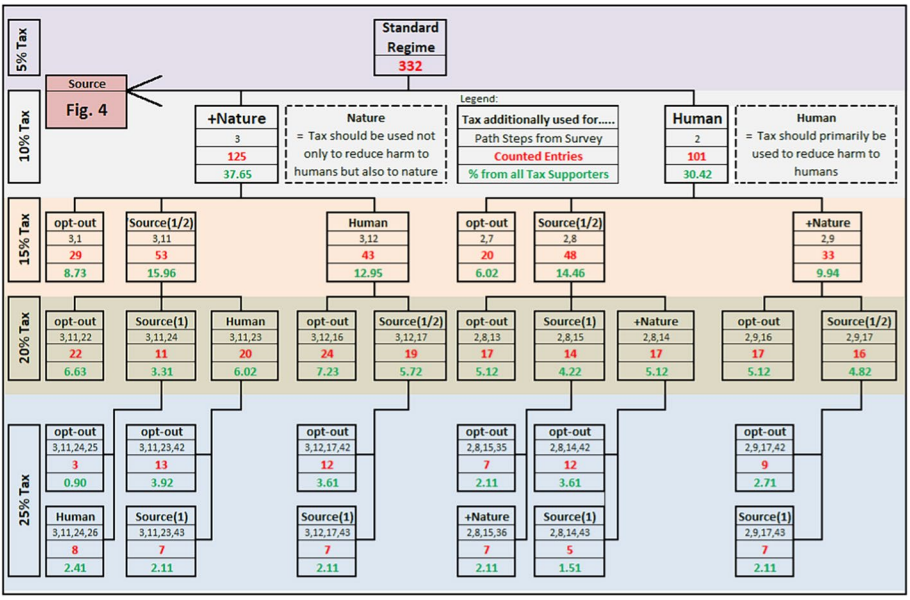

Fig. 5 Decision tree for the utilisation of tax revenues for damage regulation on humans or humans & eco-capital (+Nature)

comparison, according to Fig. 5, 30.42% from all supporters find that human capital should be much stronger protected (Path 2). However, the majority of 37.65% agreed with investing revenues likewise in the protection of nature (Path 3) in addition to the initial

Standard Regime. Since assets on nature and humans were thus mainly chosen, H4 is rejected according to Fig. 3.

In the further course, it can be seen that, after choosing additional prevention for humans or nature, part of the revenues should nevertheless be used for oil-resource preservation. 14.46% (Path 2,8) still selected a 50% oil-preservation after fully protecting human health, and 15.96% (Path 3,11) after opting for additional protection of nature. Agreeing with a complete renouncement of oil-extraction concerned far fewer supporters with 4.22% (Path 2,8,15) and 3.31% (Path 3,11,24), respectively. Thus, if 50% of oil has already been preserved, the need for further protection is then of minor importance.

Obviously, most tax supporters see the plastic problem in nature as more urgent than caring about humans only, because 37.65% (Path 3) want that the tax increase from 5 to 10% is likewise used for regulating damage to nature. These are contrasted by 30.42% (Path 2) who want that the same amount is furtherly invested in human damage control. This initially rejects H5 according to the conditions laid down by Fig. 3. However, there remains an interest in whether the variables from Block 2 influenced these two opposing views. As Table 4 shows, a significantly weak effect only came from attitudes towards active environmental protection (V_{Att}), and this has high model goodness. Interesting, however, is the negative sign of $r = -0.14$, meaning that people with a higher environmental commitment see the protection of only humans in the foreground. A correlation with V_{Avoid} can now be discarded, in contrast to its influence on the decision in favour of a tax (H2). Thus V_{Att} is a reliable indicator for the opinion of which damage should primarily be reduced and avoided. Since there is obviously an effect, this at least partly rejects H5.

4.5 Maximally achievable tax rates and revenues

Figure 4 shows that after initial choice of oil-resource preservation, only 4 of 8 subpaths found approval also at highest tax level of 25%. However, this concerns only 6 respondents out of a total of 332 supporters. Significantly more people approached the maximum rate when they initially help the damaged biosphere with their revenues. 15.96% + 3.31% = 19.07% of all payers then additionally decided for completely preserving oil-resource through bioplastics substitution (Path 3,11,24), and finally another 2.41% advanced to 25% rate for finally investing in human capital again (Path 3,11,24,26). When humans were first protected, and oil-resource preservation is in second place, then a slightly smaller share of 2.11% still supported nature at 25% tax (Path 2,8,15,36). In the same main path "Human", a similar end-result is achieved when nature is protected before completely preserving oil-resources (Path 2,9,17,43). Hence, taxation primarily for the purpose of oil-resource preservation not only encourages fewer supporters, but particularly high rates become less likely. On the other hand, most people support highest rates after additional nature protection and, as second best, after a major human capital regulation. Therefore, H6 is ultimately maintained according to Fig. 3.

More interesting, however, is the question of which regulatory target generates the largest tax revenues, and how high the tax rate then becomes. For this purpose, Figs. 6, 7 and 8 present the number of supporters depending on the rate. As can be seen, as rates rise, the share of supporters falls, but this varies according to the main utilisation. Figure 6 shows the optimal rate/supporter-allocation (= grey area). Accordingly, keeping the initial 5%-tax as Standard Regime, which is no oil cut while using tax revenues for health prevention (Fig. 5: Path 1,4), is accepted by more taxpayers under a lower rate (100% Source Exploitation: slope = −0.36). However, a complete cut is favoured by far fewer persons under

Table 4 Factors influencing the primary use of tax revenues for only human or also eco-capital regulation

Statistics:	Regulation of human capital ($V_{Util}=1$):	Regulation of human & nature capital ($V_{Util}=2$):
Descriptive:	30.42%	37.65%
Hypothesis:	37.65 > 30.42: H5 rejected	
Effect size:	V_{Att}	$\chi^2=6.15$; $p=0.042$; df = 4; $r=-0.14$; $\chi^2/df=1.5$; RMSEA = 0.05
	V_{Avoid}	$\chi^2=0.95$; $p=0.914$; df = 3; $r=0.01$; $\chi^2/df=0.3$; RMSEA = 0.00
Hypothesis:	$p(V_{Att}) \leq 0.05$ and $r(V_{Att}) \geq 0.10$: H5 partly rejected	

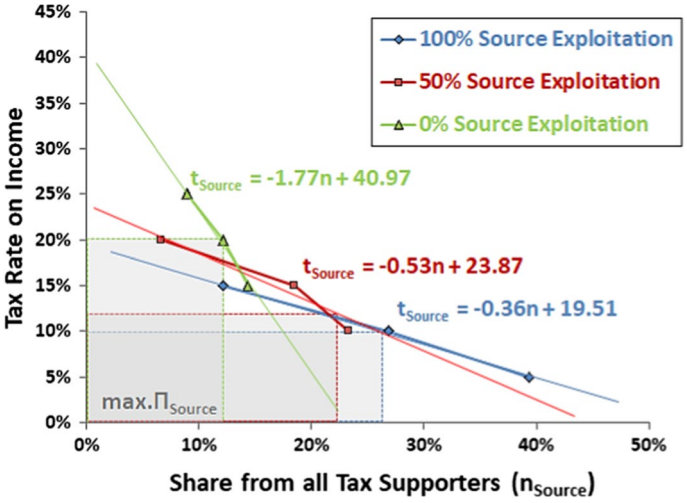

Fig. 6 Share of supporters per tax rate for the purpose of tax-financed oil-resource preservation

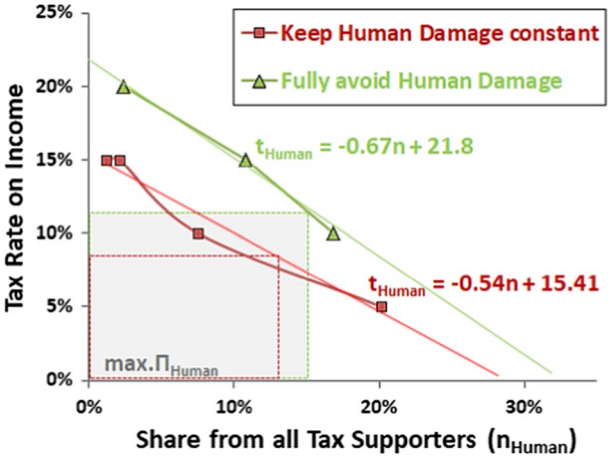

Fig. 7 Share of supporters per tax rate for the purpose of a tax-financed damage regulation to human capital only

much higher tax (0% Source Exploitation: slope = −1.77). Table 5 additionally reveals that the former case generates a maximum of 2.71 tax revenues under $t = 10\%$, instead of 2.31 under $t = 20\%$, thus the former is more effective. In comparison, all curves in Fig. 7 for major human regulation decline similarly. Completely avoiding damage to humans yields comparatively more tax revenue (Table 5: $\Pi = 1.79$) under $t = 11\%$ (Fig. 5: Path 2) than keeping damage constant (Table 5: $\Pi = 1.14$). According to Fig. 8, the graph for complete damage reduction to human & nature (Fully avoid nature damage: slope = −0.38) is equally inclined as for "100% Source Exploitation" in Fig. 6, but regulates much stronger. This measure finds approval from far more payers than focussing on human health only. And it achieves a higher rate of 13% according to Table 5, yielding its maximum revenue at $\Pi = 4.59$. According to Fig. 5, most people in Path 3 prefer 50% oil-resource preservation (Path 3,11: 15.96%) in addition to nature protection, and second most a further human health protection (Path 3,12: 12.95%). A higher plastic tax should therefore reduce nature

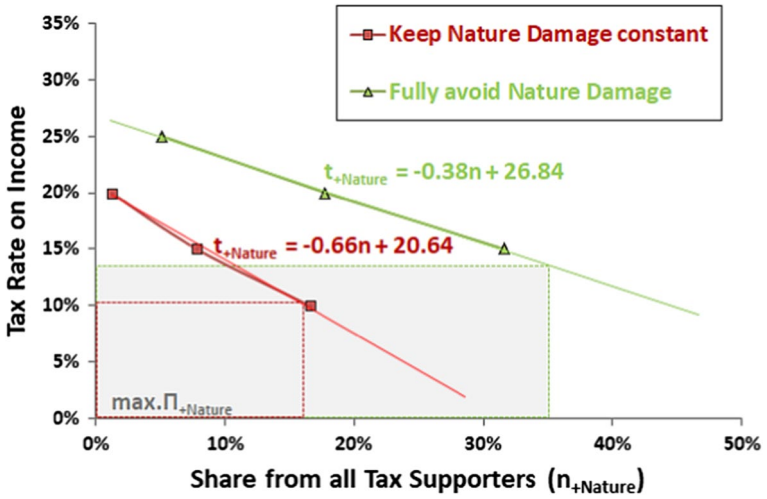

Fig. 8 Share of supporters per tax rate for the purpose of a tax-financed human & nature capital damage regulation

Table 5 Tax revenues at maximisation optimum according to different regulation targets

Utilisation of tax revenues as regulation target (V_{Util}):	Measure:	Optimal tax rate: t^{opt}_{Util} [%]	Optimal share of supporters: n^{opt}_{Util} [%]	Optimal tax revenues: Π^{opt}_{Util} [−]
Figure 6_Oil-Source: further exploit……	…100%	10	27.10	2.71
	…50%	12	22.52	2.20
	…0%	20	11.57	2.31
Figure 7_Human: damage should be…	…kept constant	8	14.27	1.14
	…driven down	11	16.27	1.79
Figure 8_Nature: damage should be…	…kept constant	10	15.64	1.56
	…driven down	**13**	**35.32**	**4.59**
Hypothesis:	Maximally achievable revenues differ: H7 maintained			

impacts and oil-extraction as main targets. For rejecting H7, Fig. 3 demands similar revenues, which is not the case here.

5 Discussion

The previous section indicates that most Germans with own income, and particularly women, are in favour of a plastic tax. For Heidbreder et al. (2019), taxing plastic consumption is a very popular regulatory instrument. This study demonstrated that this is also true if taxation is independent of consumption. In addition, the findings confirm Evans et al. (2017), who regard an environmental tax as a perfect internalisation measure. In fact, acceptance is a basic prerequisite for the functioning of the tax since the payers should

see it as a necessity and less as a public income source. According to Feucht and Zander (2018) and Orset et al. (2017), consent to a tax is expectedly high when emission-intensive goods are in the focus, which is certainly the case with petroplastics. In this context, Nguyen et al. (2016) suggest regulating damage either through such taxes on consumption of brown goods or through price relief on green products, although now the former proved to be effective from a payer's perspective. Nevertheless, the results also indicate that the rejection of a plastic tax is not an expression of lower environmental thinking, because both groups were identical in their attitude. Effective regulatory policy should therefore not only rely on taxation.

This study found the broadest acceptance at 15% tax, with a tendency towards even higher rates. A reliable indicator for this is a positive opinion on active environmental protection. This confirms Park et al. (2017), who saw a tax morality linked to green ethos. This is now substantiated with a concrete value for applicable tax rates. According to Shao et al. (2018), the middle-income class shows highest WTP for environmental measures. However, the present study proved that the acceptance of high tax burdens is more pronounced among younger people, who then have less income. Interestingly, willingness to pay taxes was not correlated with plastics avoidance efforts. This weakens Säll and Gren's (2015) argument that taxing the consumption of brown technologies reduces their pollution potential through increased avoidance. In contrast, Heidbreder et al. (2019) bring the rebound effect into play, because paying a plastic tax can give consumers a better conscience, and consumption actually increases. Helm (2016) therefore demands that the use of tax revenues, e.g. for damage repair, must be clearly defined and communicated to consumers. According to the study, consent to higher rates was not only triggered by environmental awareness and age, but also more favoured by women. Brécard et al. (2009) found comparable influence from both socio-demographic variables, Sidique et al. (2010) only for age, and Friedrich (2020) additionally for household size. On the other hand, Klein et al. (2019) and Friedrich (2021) did not, and the study by Van et al. (2021) could not at all prove an association of avoidance efforts with environmental awareness. This shows that an effect from these factors varies greatly depending on the study target, and comparisons should only be made with caution. Nevertheless, this section finds that women are not only more likely to agree with taxation, but are then also more willing to bear higher financial burdens.

The analyses revealed that regulation targets should consider the occurrence side more than the cause side. If, nevertheless, oil-resources were primary conserved, while using biopolymers instead, then this should not happen entirely. Further exploitation of finite resources is thus tolerated. While this confirms Walker et al. (2020) and Papageorgiou (2018) that the purpose-related plastic tax in principle promotes the use of biopolymers, the effect is not consistent enough from the consumer's point of view. The result rather supports the demand of Erickson et al. (2018) that effective resource preservation must take place through the withdrawal of drilling permits and mining rights. According to the study findings, the consent to spending revenues on damage reduction is far higher. Here, payers have recognised the risks to humans, as postulated by Waring et al. (2018), Wright and Kelly (2017) and Hwang et al. (2019), while oil-extraction will continue and keep consumption high. From an economic perspective, this is initially desirable as long as nature gets not permanently lost. The fact, that this was also in the interest of the respondents, is shown by the highest preference for tax allocation in favour of eco-potential. Thus, as envisaged by Waring et al. (2018), Verma et al. (2016) and Beaumont et al. (2019), environmental hazards from plastics are well known among the population, and risk mitigation through spending tax revenues is explicitly desired. Contrary to what one might expect, the

study revealed that a pronounced environmental attitude shifts the focus more on human well-being, rather than likewise prioritising nature & wildlife. This supports the initially surprising thesis of Birch et al. (2018) that self-interested motives trigger environmentally friendly actions more than altruism does. Now, this abstract and general finding can be supplemented by the aspect that striving for one's own welfare can explain environmentally friendly action.

Finally, it was demonstrated that a plastic tax should be levied primarily for regulating damage to nature & wildlife in addition to humans, and, as a secondary objective, for partly preservation of oil-resources. Then it will find the broadest acceptance for a maximal achievable rate. The fact, that tax utilisation plays a role, is reinforced by Fairbrother (2019) who focused on the interest of tax payers in revenue spending. Park et al. (2017), however, found that this effect is culture-specific. The present study thus extends the current literature that, at least among Germans, awareness of how tax revenues are used has a significant influence on acceptance, which attests a pronounced desire for involvement in regulatory policies. The derived optimal tax rate at 13% verifies and substantiates the range of 8.9–33.3% for an appropriate environmental taxation of meat, as determined by Säll and Gren (2015). Although such a good was not under investigation here, it nevertheless calls for counter-checking regulatory instruments against consumers' WTP, because it is obviously high and should be skimmed off for effective damage internalisation. However, Goulder et al. (2019) demand that such a tax should not weaken consumer capital, because they make their decision in the light of their income, hence, also in this study. After all, they largely decided against primary restricting consumption as a result of excessive oil-resource preservation. Obviously, despite a plastic tax, consumption should remain high and continue promoting gross domestic product.

6 Conclusions

This study investigated the willingness of consumers to participate in the regulation of oil-resource exploitation and damage to humans and nature from plastic consumption. A fictitious plastic tax was proposed, as planned by the European Commission, but levied on income. One of the main findings is that consumers, as contributors to the damage caused by plastic, want to participate financially in regulatory measures in a spirit of solidarity. So regulation should not only be at the expense of producers. An effective tax regime should take into account age, gender and preferences for tax use. From a scientific point of view, the results support future environmental economic analyses on damage regulation. From the empirically verified basic assumptions on the most effective regime, financial budgets can be determined and their ecological usefulness analysed. The following list summarises the findings according to theoretical and practical implications:

(1) Asking consumers to renounce on income does not seem to be very effective at first, because homo economicus rather tries to maximise budget. However, 72.8% supported a tax, and scarifying income in favour of environment is seen as beneficial, and less of a loss in utility.
(2) Plastic tax opponents and supporters are statistically similar ($p = 0.660$) regarding their environmental mindset. Hence, a regulatory goal should not only be realised on the basis of taxation, but should offer alternative forms of participation. For example, men were more likely to reject the tax ($r^{\text{correl}} = 0.11$), which is why credits for physical

engagement in environmental protective measures might capture their interest more than passive tax payments.

(3) Among supporters, WTP tends towards higher tax rates, because a total of 66.6% agreed with rates equal or more than 15%, and this is triggered by environmental awareness ($r^{\text{correl}} = 0.22$). Payers should therefore receive a second dividend, in addition to the taxation target of the first dividend. This can be, for example, reduced health insurance fees or lower waste disposal charges.

(4) Tax willingness obviously depends on communication about how to use revenues, because 37.65% agreed with damage regulation on human & nature instead of only 19.28% opting for oil-resource preservation. Hence, regulators should clearly state the purpose and expected effects from the tax. For instance, consumers could be informed about which measures are to be financed by next year's tax or, even better, consumers could vote on future measures.

(5) According to the study, environmental conscience is positively and moderately associated with high interest in one's own health ($r^{\text{correl}}\ (V_{\text{Att}} \mid V_{\text{Human}}) = 0.14$). Regulation policy should therefore focus on the positive consequences from a tax for peoples' well-being. This stimulates active contribution to environmental protection or willingness to pay the tax, the latter more among women.

(6) With a weak correlation of 0.18, younger people accepted higher taxes more. This is a positive signal for the state's fiscal policy, because this group might continue adhering to this form of financial participation in the future, which gives reason to believe in stable state revenues.

(7) 19.28% chose 50% oil-resource preservation at 10% tax burden, and then only 0.60% chose complete oil-avoidance at 15% tax (Path 1,5,21). This suggests that people fear restricted consumption under such preventive measures. Nevertheless, if this is politically desired, alternative materials should be available in time, such as bioplastics.

(8) However, completely substituting petroplastics with biopolymers showed rather moderate acceptance with only 2.71% supporters (Path 1,6). This material therefore remains more of a niche technology, or consumer confidence must be increased instead. For the time being, the government should promote a switch to bioplastics in selected applications only.

From the study results and the current developments of environmental damages from plastics, the author's overall impression is that a private plastic tax becomes very likely. It is already accepted today, can obviously effectively provide the necessary money for damage regulation and prevention measures, and at the same time influences consumer behaviour by tightening their budget.

This study is also subject to limitations. For example, respondents were only placed in a hypothetical situation, and they may have answered too optimistically. This bias was reduced by always discussing results in comparison with the other regulation targets. Moreover, the results come from German respondents and can only be generalised to a limited extent. Nevertheless, they are representative at least for Central Europe. Also, the number of latent variables, comprising environmental attitude and degree of plastics avoidance, is rather low.

In further studies, it should be found out why tax opponents decided this way, since their characteristics were almost identical to the supporters. Another question is how much concern for one's own health played a role among the 30.42% who placed the

protection of humans above eco-capital. It would be worth knowing whether current health issues were the reason.

Appendix:

Questionnaire 2nd page with queries of Block 1 and Block 2 (translated from German)

Continue 1.1:

	How to continue with Oil Resources?	We renounce Income for Damage repair?	With this we repair the Damage to…	In the long, the Damage potential should develop in such a way…	
	1.1.	**Income sacrifice**		Please 1x tick only ↘	proceed
1	0% Relief	5%	only Humans	constant Damage	→1.2
2	0% Relief	10%	only Humans	no Damage	→1.3
3	0% Relief	10%	Humans&Nature	constant Damage	→1.4
	1.2.	**Income sacrifice**		Please 1x tick only ↘	proceed
4	0% Relief	5%	only Humans	constant Damage	→2.0-2.6
5	50% Relief	10%	only Humans	constant Damage	→1.7
6	100% Relief	15%	only Humans	constant Damage	→1.12
	1.3.	**Income sacrifice**		Please 1x tick only ↘	proceed
7	0% Relief	10%	only Humans	no Damage	→ 2.0-2.6
8	50% Relief	15%	only Humans	no Damage	→1.5
9	0% Relief	15%	Humans&Nature	no Damage	→1.6
	1.4.	**Income sacrifice**		Please 1x tick only ↘	proceed
10	0% Relief	10%	Humans&Nature	constant Damage	→2.0-2.6
11	50% Relief	15%	Humans&Nature	constant Damage	→ 1.8
12	0% Relief	15%	Humans&Nature	no Damage	→1.6
	1.5.	**Income sacrifice**		Please 1x tick only ↘	proceed
13	50% Relief	15%	only Humans	no Damage	→2.0-2.6
14	50% Relief	20%	Humans&Nature	no Damage	→1.16
15	100% Relief	20%	only Humans	no Damage	→1.13
	1.6.	**Income sacrifice**		Please 1x tick only ↘	proceed
16	0% Relief	15%	Humans&Nature	no Damage	→ 2.0-2.6
17	50% Relief	20%	Humans&Nature	no Damage	→1.16
	1.7.	**Income sacrifice**		Please 1x tick only ↘	proceed
18	50% Relief	10%	only Humans	constant Damage	→2.0-2.6
19	50% Relief	15%	Humans&Nature	constant Damage	→1.8
20	50% Relief	15%	only Humans	no Damage	→1.10
21	100% Relief	15%	only Humans	constant Damage	→1.15
	1.8.	**Income sacrifice**		Please 1x tick only ↘	proceed
22	50% Relief	15%	Humans&Nature	constant Damage	→2.0-2.6
23	50% Relief	20%	Humans&Nature	no Damage	→1.16
24	100% Relief	20%	Humans&Nature	constant Damage	→1.9
	1.9.	**Income sacrifice**		Please 1x tick only ↘	proceed
25	100% Relief	20%	Humans&Nature	constant Damage	→2.0-2.6
26	100% Relief	25%	Humans&Nature	no Damage	→2.0-2.6
	1.10.	**Income sacrifice**		Please 1x tick only ↘	proceed
27	50% Relief	15%	only Humans	no Damage	→ 2.0-2.6
28	50% Relief	20%	Humans&Nature	no Damage	→1.16
29	100% Relief	20%	only Humans	no Damage	→1.11
	1.11.	**Income sacrifice**		Please 1x tick only ↘	proceed
30	100% Relief	20%	only Humans	no Damage	→2.0-2.6
31	100% Relief	25%	Humans&Nature	no Damage	→2.0-2.6
	1.12.	**Income sacrifice**		Please 1x tick only ↘	proceed
32	100% Relief	15%	only Humans	constant Damage	→2.0-2.6
33	100% Relief	20%	only Humans	no Damage	→1.13
34	100% Relief	20%	Humans&Nature	constant Damage	→1.14
	1.13.	**Income sacrifice**		Please 1x tick only ↘	proceed
35	100% Relief	20%	only Humans	no Damage	→2.0-2.6
36	100% Relief	25%	Humans&Nature	no Damage	→2.0-2.6
	1.14.	**Income sacrifice**		Please 1x tick only ↘	proceed
37	100% Relief	20%	Humans&Nature	constant Damage	→2.0-2.6
38	100% Relief	25%	Humans&Nature	no Damage	→2.0-2.6
	1.15.	**Income sacrifice**		Please 1x tick only ↘	proceed
39	100% Relief	15%	only Humans	constant Damage	→2.0-2.6
40	100% Relief	20%	only Humans	no Damage	→1.13
41	100% Relief	20%	Humans&Nature	constant Damage	→1.14
	1.16.	**Income sacrifice**		Please 1x tick only ↘	proceed
42	50% Relief	20%	Humans&Nature	no Damage	→2.0-2.6
43	100% Relief	25%	Humans&Nature	no Damage	→2.0-2.6

Please now complete 2.0 to 2.6:

2.0 Household size		
44	1 Person (Single)	
45	2 Persons (Couple)	
46	>2 Persons (Family)	
2.1 Your professional activity		
47	Apprenticeship / Study	
48	In employment	
49	Retired	
50	others	
2.2 Your highest degree?		
51	School-leaving exam	
52	Apprenticeship, Technician	
53	Study (Bachelor/Master/Dipl./PhD)	
2.3 Your gender		
54	female	
55	male	
2.4 Your age		
56	<29	
57	30….39	
58	40….49	
59	50….59	
60	>60	
2.5 Your contribution to environmental protection		
61	little	
62	adequate	
63	much	
2.6 I actively avoid petroplastics		
64	little	
65	adequate	
66	much	

Infobox: Choice Criteria

Oil-Resource Conservation:

0% = Oil extraction as before or even more

50% = Cut degradation in half and supplement with bioplastics from plants instead

100% = No more resource extraction and only use biopolymers

Participation through income renouncement:

Everyone should contribute to the prevention and repair of damage from previous plastic consumption with 5% to 25% of their own income.

Who benefits from the income sacrifice:

The participation serves to develop new technologies in order to prevent or remedy future damage to humans and nature from plastic consumption and oil extraction.

How should damage still occur in the future:

Prevent further increase in damage with the technologies and maintain or completely eliminate current damage

End: Thanks for cooperating!

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Declarations

Conflict of interest The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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