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A choice experiment on fuel taxation and earmarking in Norway

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Sammendrag: Pigouvianske skatter er et kostnadseffektivt miljøpolitisk virkemiddel, men er upopulært blant velgere. Øremerking av skatteinntekter har vist seg å øke støtten til skatter og avgifter, men denne praksisen representerer i følge økonomisk teori et avvik fra optimal utforming av virkemidler. Denne motsetningen mellom kostnadseffektivitet og politisk gjennomførbarhet er inspirasjonen bak dette studiets formål om å kvantifisere effekten av øremerking på støtte blant velgere til å øke drivstoffavgiften. Et annet formål er å undersøke *hvorfor* øremerking øker støtten. Studiet estimerer modeller av velgeres preferanser for drivstoffavgifter basert på data innsamlet gjennom et valgekspériment utført på et utvalg av 1177 respondenter representative for den norske velgermassen. Statistiske analyser er utført ved hjelp av logistiske regresjoner. Resultatene viser at øremerking av skatteinntekter til miljøformål har en betydelig effekt på velgernes støtte til forslag om å øke drivstoffavgiftene, og skaper flertall for å øke avgiftene med nærmere 20 prosent fra dagens nivå. Øremerking av økte skatteinntekter til inntektsutjevning resulterer ikke i flertall for å øke avgiftene. Videre analyse viser at en hovedgrunn til at øremerking til miljøtiltak er populært er fordi det øker den *oppfattede* miljøeffekten av skatteøkningen, og dermed dens legitimitet som miljøpolitikk heller enn skattepolitikk.

Abstract: Pigouvian taxes are efficient - but unpopular among voters. Earmarking of revenues has been widely reported to increase support for taxes, but this practice represents a deviation from optimal policy design. This trade-off between efficiency and political feasibility is the inspiration for this paper's attempt to quantify the effect of earmarking on voter support for fuel tax rises. Another aim of the paper is to investigate *why* earmarking increases support. The study estimates models of voter preferences for fuel taxes based on data are collected through a choice experiment conducted on a sample of 1177 respondents representative of the Norwegian voter population, and fitted using logistic regression models. The results show that earmarking the revenues for environmental measures has a substantial effect on voter support for fuel tax increases, garnering a majority for increases of up to 20 per cent above present levels. Earmarking the additional revenue for income redistribution does not result in a majority for any increase. Further analysis indicates that a prime reason why earmarking for environmental measures is popular is that it increases the *perceived* environmental effectiveness of the tax, and hence its legitimacy as an environmental rather than a fiscal policy.

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1 Introduction

According to economic theory, efficiency can be improved by imposing Pigouvian taxes when there is an environmental externality. In reality, however, Pigouvian taxes have proven politically challenging. Therefore, some externalities are left unaddressed, while others are addressed through less efficient instruments. When taxes are used they are often set below the optimal level. A prime reason is opposition among the public.

Earmarking has been widely reported to increase the public acceptability of taxes, despite the recommendation from economists that government spending decisions should be divorced from taxation decisions. Because it represents an important trade-off between acceptability and efficiency, the overall research question for this study is why and to what extent earmarking can increase the public acceptability of environmental taxes.

The next section presents a review of the literature on earmarking, with a particular focus on the role of earmarking in garnering public support. Based on this literature review we define our research questions and hypotheses in section 2. We present the survey and method in section 3, analyse the responses in section 4, and draw our conclusions in section 5.

1.1 Literature review

The issue of earmarking and support for environmental taxes has been discussed in both the public finance/political economy literature, and in the environmental economics literature. We will briefly review the discussion on whether or not revenues ought to be earmarked, before we turn our attention to the main topic of this paper: why and to what extent can earmarking increase the public acceptability of environmental taxes?

In public finance theory the textbook recommendation is that the government should divorce its spending decisions from its fund-raising or taxation decisions so that spending can be undertaken unconstrained and solely based on benefit-cost considerations (Musgrave and Musgrave, 1984, p.231). There are also other arguments against earmarking of general taxes. Dilnot (1993) and Wilkinson (1994) both argue that citizens can be deluded when the government makes offsetting decisions on other issues in which there is no earmarking.

It should be noted that under certain conditions a theoretical argument can be made for the efficiency of earmarking. Buchanan (1963) and Goetz (1968) argue that when there is a high degree of correspondence between who pays the tax and who benefits from the use of revenues, earmarking reveals taxpayer preferences for public services, sending a clear demand signal to policy makers about how much of the public services should be supplied. This has been noted even by Musgrave (1938), who can be seen as the father of the orthodox public finance approach, although he has been careful to specify the limited practical applicability of the argument. Indeed, the applicability is limited to user charges for services whose characteristics are closer to private than public goods. The types of earmarking that will be considered in this study do not satisfy criteria for efficient earmarking. Other authors have promoted earmarking based on considerations such as transparency (Bracewell-Milnes, 1993), earmarking as a commitment device (Marsiliani and Renström, 2000, and Brett and Keen, 2000), and asymmetric information (Pirttilä, 1999). Nevertheless, the economic rationale for earmarking remains weak. It may, however, make good political sense. An important argument is that earmarking taxes makes them more popular and increases the likelihood that they will be implemented. This issue, why and to what extent earmarking can increase the public acceptability of environmental taxes, is the main focus of this paper.

The general efficiency argument in favour of divorcing taxation and spending decisions has also been important in environmental economics. In the 1990s there was wide debate about how the revenues from Pigouvian taxes should be spent (see surveys on the debate in Oates and Parry, 2000, and Schöb, 2005). Gordon Tullock (1967) introduced the idea that a Pigouvian tax might offer a second benefit (the improvement in environmental quality being the first), if the revenue was used to reduce distortions in the tax system, an idea made popular by David Pearce (1991) with the term “double dividend.” While there seems to be general agreement that “revenue-recycling” (using the Pigouvian revenues to reduce distortionary taxes) produces a higher welfare gain than returning the revenues lump-sum, whether a Pigouvian tax will impose net costs or net benefits (when environmental benefits are excluded), has been hotly debated. There are two forms of the double dividend hypothesis. The weak form of the hypothesis is relatively undisputed among economists: the second dividend of the environmental tax comes in the form of improved efficiency if its revenues can be used to cut distortionary taxes (the first dividend is environmental improvements). The strong form of the hypothesis is that the tax actually increases non-environmental welfare independent of whether there are any environmental benefits. Whether the strong form holds is unclear and depends on the tax structure of the economy (Schöb, 2005). The weak form of the double-dividend hypothesis is widely accepted. Earmarking revenues from an environmental tax for other public projects (as opposed to using them to lower distortionary taxes) has the effect that the second dividend will not materialize.

The result that earmarking the revenues from an environmental tax would increase public acceptability seems very robust and is confirmed by a wide range of studies across many countries.

An international poll of 22,000 people in 21 countries found that 50% supported higher energy taxes, and that the support rose to 77% if the revenues were earmarked for promoting energy efficiency or developing cleaner fuels (Globescan and PIPA, 2007). Similar results are found by for instance Banister (2003), Harrington et al. (2001), Hsu et al. (2008), Ison (2000), Schade and Schlag (2003), Schuitema and Steg (2008), Steg et al. (2006) and Thalmann (2004). One weakness shared by many of the existing studies is that the respondents face only two different options: an earmarked tax and a non-earmarked tax, hence they arrive at a point estimate of how much earmarking can increase acceptability, but are unable to draw any more general conclusions.

Given its popularity, it is perhaps not surprising that earmarking of revenues from taxes on externalities is relatively common. The OECD and the European Environment Agency in cooperation provide a database of environmental policy instruments.¹ As of July 2010 200 of the 626 national or state level environmental taxes listed in the data base were wholly or partially earmarked (OECD, 2010).

There are numerous studies that confirm the popularity of earmarking. There is, however, no consensus on why earmarking increases acceptability. In fact, there are several competing explanations for why earmarking increases public acceptability. These can broadly be classified as relating to self-interest, distrust of government, and a desire for an issue-linkage.

Self-interest

To an economist it is natural to look for the element of self-interest. Schuitema and Steg (2008) find support for the idea that “acceptability of transport pricing increases when car users expect to benefit from the allocation of revenues, which is especially the case when revenues are allocated to decrease fixed car-taxes (viz., road taxes) and variable car-taxes

¹ The quality of the data is highly variable. Several of the taxes in the database might have been more appropriately classified as user fees rather than environmental taxes (in the Pigouvian sense).

(viz., fuel taxes).” While imposing an environmental tax that internalizes external costs will increase overall welfare, it will not necessarily increase the welfare of all. Eliasson and Mattsson (2006) study the equity effects of the (then proposed, now implemented) Stockholm congestion charge, and find that the use of the revenues is crucial for the net distributional effects: an effect that is accentuated by “the fact that the total collected charges are more than three times as large as the net benefits”. A rational self-interested voter would support an environmental tax scheme only if he or she expected to gain a personal benefit if the tax were implemented – and this depends crucially on the use of the revenues.

Distrust

Rivlin (1989) made the suggestion that earmarking is popular because without earmarking taxpayers have no clear idea of what the money is spent on, and they might believe it is spent “wastefully or even fraudulently, or that a substantial part of it goes for a services of which they disapprove of”. Goode (1984, p. 12) argues that the “prevalence of earmarking indicates a lack of confidence in the governmental system and the budgetary process”. Dresner et al. (2006a) find a fundamental lack of trust in government spending of revenue.

If people support earmarking only because they are worried that the revenues might otherwise be spent “wastefully or even fraudulently”, any specific use of the revenues should work equally well.

Issue-linkage

A further reason why people might support earmarking is that many do not believe that taxation will do much to change behaviour on its own. Dresner et al. (2006) found that “what seemed to underlie the thinking among both focus groups and some businesses was a view of taxes solely as a means of raising revenue, rather than in terms of their incentive effects. Many people could not understand that a tax on energy would have benefits for the environment even if the revenues went to labor tax reductions.” This idea is also supported by other studies. Kallbekken et al. (2008) ran a laboratory experiment with a market externality where participants voted on Pigouvian tax schemes. Only 23% of participants answered correctly in the post experimental survey that imposing the tax would improve overall welfare (in the form of monetary payoffs). Even in a treatment where it was explained to the participants how Pigouvian taxes could improve overall welfare, only 51% answered the post experimental survey question correctly. Finally, Steg et al (2006) found that “push measures” such as taxes “were perceived to be more effective and acceptable when revenues are allocated within the energy domain rather than to general funds.” While the finding that people perceive taxes as more acceptable when the revenues are earmarked should surprise no one, it is interesting that the respondents also perceived them to be more effective if earmarked.

The participants in a focus group study by Kallbekken and Aasen (in press) strongly supported earmarking, and more specifically preferred the revenues to be earmarked for mitigating environmental damage, subsidizing environmentally friendly alternatives, or financing R&D of such alternatives. Dresner et al. (2006) also find a strong preference among the respondents for measures that would bring visible environmental benefits, preferably local benefits. These findings are complemented by the result that respondents often reject suggestions to spend the revenues on other measures: Deroubaix and Lévêque (2006) find that people view it as “nonsensical to link the implementation of an energy tax and the reduction of labour taxes”.

2 Research questions and hypotheses

The overall research question for this study is why and to what extent earmarking can increase the public acceptability of environmental taxes. This consists of two separate and somewhat more precise research questions:

1. By how much can earmarking the additional revenues from an increase in the fuel tax rate increase the level of popular support compared to a non-earmarked tax rate increase?
2. Why does earmarking increase the public acceptability of a tax increase?

In order to address these research questions we define some more precise and testable hypotheses. Relating to research question 1 we test the hypotheses:

H1A) On aggregate, people prefer lower fuel taxes.

H1B) Earmarking of revenues increases public support for a fuel tax for a given tax rate.

While the first hypothesis may seem obviously true, Jaensirisak et al. (2005) noted in a study on the acceptability of road pricing that “surprisingly little attention has been paid to the impact of the level of the charge on acceptability”

Relating to research question 2 we test three hypotheses, each one relating to one of the theories presented in the literature review (“self-interest”, “issue-linkage” and “distrust”).

H2A) Earmarking is popular because voters expect to benefit personally from the use of the earmarked revenues.

H2B) Earmarking increases the acceptability of environmental taxes because of distrust in government spending of revenues. The reasoning is that: with earmarking the public can be certain of what the revenues will be spent on, and the direct link between taxation and spending makes it easier to track the money.

H2C) Earmarking is popular because people are concerned about the environmental effectiveness of the tax, and without earmarking they do not believe that the tax will improve environmental quality. The reasoning is that people do not understand how the tax gives incentives to change behaviour. Thus they want taxation and spending to be linked to the same domain/activity to ensure that the tax addresses the problem it is indeed meant to address.

3 Method

To investigate public preferences for fuel taxation, a representative sample of the Norwegian population were given a series of pair wise choices between different hypothetical proposals for changes to the fuel tax. This method is known in the literature as a choice experiment (CE). The series of choices were delivered to respondents through an online survey, which also included sociodemographic and attitudinal questions. The data collected in this way were used to estimate a model of public preferences for fuel taxation, where the main explanatory variables were the change in the tax level and the use of the additional revenue (if any). Based on this model, we can make predictions about how the Norwegian population would vote on a wide range of different proposals². The method has the advantage of presenting respondents with choice tasks that are relatively easy to comprehend, and then using advanced statistical analysis to uncover a detailed model of preferences, which includes

² Tax rates in Norway are not decided by referendums. This question format was chosen for its simplicity of understanding.

heterogeneity between people. The estimators of preferences are consistent with economic theory.

Choice experiments

Economic methods for the empirical investigation of preferences can be divided into two main groups. Revealed preference methods analyze actual transactions in markets, while stated preference methods rely on surveys with hypothetical choice situation. The choice experiment (CE) approach – an example of the latter - was initially developed by Louviere and Hensher (1982) and Louviere and Woodworth (1983). It presents respondents with a series of choice tasks with two or more alternatives and asks them to choose their most preferred alternative. An example of a choice task facing respondents in our survey is presented in Table 1. The approach has been applied extensively within inter alia transport studies (pioneered by McFadden 1974), marketing (see e.g. Carson et al 1994) and valuation of non-market goods(e.g. Hanley et al. 1998; Carlsson and Martinsson 2001; Campbell et al. 2008).

All else being equal, which alternative would you prefer?			
	A	B	Cannot answer / Do not know
Fuel tax increase per litre	NOK 1	NOK 2	-
Use of additional revenues	Income redistribution	Environmental policies	-
Tick for the preferred alternative	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Table 1: Example choice task

3.1 Choice experiment design

Because our hypotheses concern the level of tax increase, and the use of the additional revenues, the alternatives facing respondents in this survey are also described in terms of these two attributes: 1) the increase in the tax level, and 2) the use of the additional revenues generated relative to the status quo. The level of the increase takes one of five possible values: 0, NOK 0.5, NOK 1, NOK 2, and NOK 4. The use of additional revenues takes one of three different values: 1) unspecified, i.e. the revenues are used for general funds financing or for lowering other taxes. 2) earmarking for income redistribution, i.e. lowering the income tax in a way that benefits primarily low-income households. 3) earmarking for environmental measures, i.e. supporting public transport, construction of bicycle and foot paths, noise screening, or development of clean technologies. When the tax increase is zero, the second attribute is not applicable, as there is no additional revenue to spend.

The choice of these three potential uses of the additional revenues will help us address our hypotheses regarding why earmarking increases acceptability: If hypothesis 2B is correct and people like earmarking because they distrust government and fear that non-earmarked revenue will be spent on something wasteful or fraudulent, as Goode (1984), Rivlin (1989), and Dresner et al. (2006a) argue, then one would expect a difference in the popularity of the targets for earmarking only to the extent that environmental measures are viewed as a more or less worthy cause than providing support to low-income households. If, in contrast, earmarking is popular due to a concern about the environmental effectiveness of the tax (hypothesis 2C), one would expect that earmarking for environmental measures is significantly more popular than earmarking for support to low-income households.

We used the software Sawtooth to combine the two attributes with its respective values into alternatives. Alternatives were then paired up to form a choice tasks, before choice tasks were

combined into series of eight to form a choice experiment. We used a random design strategy, which means that the design of the choice experiment varied between respondents. Compared with traditional design strategies where all respondents face the same experiment, this greatly increases the number of combinations occurring, which means that the estimation of the econometric model becomes more robust. In total 300 unique choice experiments were generated. The specific design strategy we used is called complete enumeration. This strategy combines nearly orthogonal (near zero correlation between attributes) design for each respondent with minimal overlap (alternatives within each task are kept as different as possible).

In addition to the choice experiment, the questionnaire also contained a number of sociodemographic and attitudinal questions.

3.2 Sampling and delivery of survey

In March 2010 we conducted a nationwide online survey of the Norwegian population. The distribution of the questionnaire was handled by the professional survey company Synovate. It was delivered to a sample of 2777 people representative of the adult Norwegian population in terms of gender and region. People under the age of 18 (the voting age) were excluded, but other age groups were proportionally represented. The recipients had previously been recruited to a web panel and agreed to receive periodic surveys. As an incentive to participate, respondents were offered the chance of winning one out of five “universal” gift cards worth NOK 1000 each.

3.3 Econometric method

The analysis of choice experiments has two footholds in economic theory. The first is Lancaster’s characteristics theory of value (Lancaster, 1966), which postulates that any good can be completely described in terms of a bundle of characteristics and the values that these take. For example a car can be described in terms of its size, brand, engine power, price, fuel consumption etc. In our case, a tax increase is described in terms of its monetary level and the use of the revenues. The other foothold recognises that in addition to these observable characteristics, there may be some relevant aspect of a good that is unobservable, or observable only with an error. According to the Random Utility Model (RUM) (Luce, 1959; McFadden, 1973) any respondent’s (called respondent i) preferences can be represented by a utility function U_i that is decomposed into a deterministic element (V), which is typically specified as a linear index of the attribute vector (X) of the j different alternatives in the choice task, and a stochastic element (e), which represents unobservable influences on the respondents choice:

(1)

When choosing between different goods, the respondent is assumed to select the alternative that gives the highest utility. Because of the stochastic component e , choices cannot be predicted with certainty, and the analysis becomes probabilistic. The probability that a particular respondent chooses alternative g over any alternative option h in the choice set can be expressed as the probability that the utility associated with g exceeds the utility associated with all other options:

(2)

In order to estimate this probability, it is necessary to make an assumption about the

distribution of the error terms. A typical assumption is that they are independently and identically distributed with an extreme-value (Weibull) distribution. This implies that the probability that alternative g will be chosen as the most preferred option can be expressed in terms of the logistic distribution (McFadden, 1973):

$$\text{—————} \tag{3}$$

This specification is known as the conditional logit model. The coefficient vector β can be estimated by maximising the log likelihood function given in equation 4, where y_{ij} is an indicator variable which takes the value one if respondent i chose option j and zero otherwise.

$$\text{—————} \tag{4}$$

The maximization problem is solved with numerical methods using the software *Stata*. The increase in the tax rate enters the regression model as a standard continuous variable, while the use of revenue is categorical and is hence dummy-coded.

The conditional logit model is computationally simple and serves as a useful point of departure for our analysis. However, it has three main drawbacks. Firstly, it imposes a restrictive substitution pattern on the modelled preferences. A feature of the model is that the odds of choosing alternative g rather than alternative h is not affected by the addition or deletion of other alternatives. This is known as the Independence of Irrelevant Alternatives (IIA) assumption, and follows from the specification of the error terms as independent across the different alternatives in a choice task. A second limitation of the model is that it treats repeated choices a single individual makes as independent, failing to account for the panel nature of the data. Finally, the conditional logit model estimates the preferences of a representative individual. Heterogeneity in tastes can only be taken into account indirectly by creating interaction terms between some characteristic of the alternative and some characteristic of the individual, or through split-sample tests.

The mixed logit model introduced by Train (1998) obviates each of these three limitations by allowing the coefficients β_i to vary randomly across respondents:

$$\tag{5}$$

where b is a vector of fixed coefficients and η_i are unobserved deviations from the mean b for each individual that vary stochastically. The new subscript t highlights that dependencies across different choices sets faced by the same respondent are now taken into account. e_{ijt} is as the residual error term which is assumed to be identically and individually extreme value distributed across respondents, alternatives and choice sets. The fact that the coefficients now vary randomly across respondents allows for unobserved variations in taste. Since η_i is allowed to be correlated across alternatives, the IIA assumption is obviated. The fact that it is also correlated across choice sets allows the panel nature of the data to be incorporated. Finally, the fact that the coefficients can vary randomly between respondents explicitly allows for taste heterogeneity. The last point is a particularly important advantage when predicting voting behaviour, as we will be doing.

If β_i were known for each respondent, the alternative of choosing any alternative in a particular choice task would be given by equation 3. In a panel of data where each respondent makes repeated choices, the conditional probability that respondent i makes a particular

series of choices $\mathbf{y}=\{y_1,\dots,y_T\}$ is simply the product of the conditional logit probabilities for each choice:

(6)

But since β is unknown, equation 6 must be integrated over all values of β weighted by the density of its distribution:

(7)

To estimate the model, one needs to make some assumption about the distribution of each coefficient. We will use the normal distribution: $f(\beta)\sim N(b,\sigma^2)$ where b and σ are parameters to be estimated. Fixed coefficients with degenerate distributions $\beta=b$ can also be included. The model is estimated with simulated maximum likelihood estimation using Stata. For details see Train (2003).

While the mixed logit model is a more general model than the conditional logit model, we include also the latter because of its simplicity and transparency, and to check for robustness of the results across model specifications. In addition, the conditional logit model is best suited for including interactions between attributes of the alternatives and attributes of the respondents.

In order to investigate why earmarking is popular, we will analyze how certain personal attributes affect preferences for earmarking. Personal characteristics cannot be entered directly into the logit models used here, since they do not vary across choice alternatives. However, they can be interacted with attributes of the alternatives. Hence one can find out what types of people prefer the different uses of revenues. The personal attributes included are selected in order to differentiate between the three mentioned hypotheses as to why earmarking increases acceptability. They were elicited by presenting respondents with a series of statements and asking them to indicate the extent to which they agreed on a five-point Likert scale. One such statement was: "In order for fuel taxes to have an environmental effect it is crucial that the tax income [revenues] are earmarked for environmental measures." The statement intended to measure the level of trust in government spending decisions read: "The government makes reasonable use of the income [revenue] from taxes and fees." Finally the respondents were asked to indicate to what extent they expected to benefit personally from the three forms of revenue use; unspecified, earmarked for income redistribution, and earmarked for environmental measures. Interactions between these variables and revenue use are included in an expanded regression model.

4 Analysis

In total, 1250 people responded to the survey which implies a response rate of 45%. Out of those, 1177 completed the entire survey, and are included in the analysis. The option *do not know/cannot answer* was chosen in 10 per cent of the total number of tasks. Table 2 can be used to check for self-selection effects in terms of gender, age and region. It shows that the final sample is a good representation of the population of Norwegian voters with respect to these variables. The reason for the difference between the sample and population values for mean age is that people below the age of 18 were excluded from the sample.

Variable	Statistic	Population	Sample
Gender	% female	50.00	49.70
Northern Norway	% of total	9.58	11.30
Middle Norway	% of total	8.69	9.26
Western Norway	% of total	26.00	24.81
Southern Norway	% of total	5.74	5.95
Eastern Norway	% of total	49.98	48.68
Age	mean	39	46

Table 2: Summary descriptive statistics

4.1 Treatment of potential protest responses

A general problem in stated preference studies is that some respondents might cast their responses to signal disapproval of the question rather than giving the response that best reflect their preferences. In this survey, people were in many choice tasks asked to choose between two different proposals that would both raise the tax on fuels. There is a potential risk that respondents who do not favour a tax increase could reject such a choice. We took three measures to mitigate the risk that such a reaction would influence our results and the analysis. Firstly, the instructions stated that “If you do not like any of the alternatives, it is important that you tick off for the alternative you oppose the least”. Secondly, a non-response option (*do not know/cannot answer*) was included in each choice task, to avoid those who strongly oppose taxes to self-select themselves out of the entire survey. Thirdly, we used the data on non-responses in combination with responses to a different question gauging the attitudes towards fuel taxation in order to create weights to compensate for strong opposers choosing the non-response as a protest. This question was “If there was a referendum today on what should happen to the fuel taxes, i.e. the taxes on gasoline and diesel, which alternative would you vote for?” The respondents could choose between the options removing the taxes, decreasing the taxes by NOK 1/litre, no change, increasing the taxes by NOK 1/litre, and doubling the current tax rates. Based on which of the five categories they chose for this question, respondents were given a weight in the analysis of the choice experiment results according to the following formula

$$(8)$$

Those who chose the option of removing existing taxes were slightly overrepresented among non-respondents in the choice experiment and were assigned a weight of 1.04. This was the largest weight used, and its modest size indicates that protest responses have not been very prevalent.

4.2 Regression results

Table 3 reports the main regression results. Four different models are included, with slightly different specifications. These will be discussed in turn. Model 1 is the basic conditional logit regression. In addition to the continuous variable *taxrise*, the model includes three dummy variables. The dummy labeled *Environment* indicates that the additional revenue is earmarked for environmental measures, while the dummy *Redistribution* indicates that it is earmarked for income redistribution. We chose unspecified use of revenue as the reference category, hence there is no dummy variable for this option. When *taxrise* takes the value of zero, there is no additional revenue to spend. The dummy variable *zero* identifies these cases. All the coefficients are significant at any conventional level of confidence. The

table reports the standard measure of goodness of fit for logit models, the likelihood ratio index, also known as McFadden’s pseudo R^2 , which is given by

$$\frac{LL(b) - LL(0)}{LL(0)} \quad (9)$$

where $LL(b)$ is the is the log likelihood functions value at the estimated parameters, and $LL(0)$ its value when all parameters are set equal to zero. The values obtained indicate that the models fit the data relatively well.

The negative coefficient for *taxrise* shows that respondents prefer lower taxes, *ceteris paribus*. This supports our hypothesis 1A. The positive coefficients for the two earmarking dummies show that earmarking of revenues increases the accept for fuel taxes, as stated in hypothesis 1B. In relation to our second research question, it is interesting to note that the coefficient for *environment* is several times larger than the coefficient for *redistribution*. This is consistent with hypothesis 2C that people have a strong preference for a link between the externality that the tax is imposed on and the proceeds of the revenue. However, it could also be that people have a stronger preference for governments spending on environmental measures than for supporting low-income households irrespective of how it is financed. To control for the latter effect, the regression was re-run including only respondents who stated that they were not at all concerned with the environmental effects of driving *and* displayed a strong concern for low-income households by completely agreeing with the statement “Increasing fuel taxes is unfortunate because it negatively affects low-income households (Model 2)”. Even within this subgroup of 258 respondents, the coefficient *earmarking* is 1.7 times as large as the coefficient for *redistribution*. This shows that the preference for earmarking to environmental measures cannot be explained by a stronger concern for the environment than for low-income households. Hence it supports hypothesis 2C. This is also consistent with the fact that in practice there is a clear tendency for tax revenue to be earmarked for a purpose directly related to the tax-liable activity: environmental taxes are earmarked for environmental purposes (OECD, 2010).

	Model 1		Model 2		Model 3		Model 4	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
taxrise	-0.528	-29.3	-0.674	-10.3	-0.603	-25.3	-0.751	-28.0
redistribution	0.397	8.0	0.719	4.2	0.415	7	0.256	3.0
environment	1.313	25.8	1.241	7.3	1.361	22	1.665	18.9
zero	0.841	15.8	1.390	7.7			0.841	12.7
st. dev. Redistribution							1.687	17.1
st. dev. Environment							1.877	18.5
pseudo-R²		0.26		0.38		0.29		0.31

Table 3: Estimated coefficients from logistic regressions

The large and significant coefficient for the *zero* dummy indicates that responses displayed a strong status quo effect. The status quo effect refers to a consistent observation in behavioural and experimental economics that an alternative is more likely to be chosen when it is perceived as the status quo than when it is perceived as an alternative to the status quo (see

for example Tversky and Kahneman 1991). In our results it is embodied as larger difference in preferences between zero increase and a NOK 1 increase than between a NOK 1 increase and a NOK 2 increase. If there were no status quo effect, one would expect the coefficient of the *zero* dummy to be close to zero, as the use of revenues from the current fuel tax is unspecified, and the reference category for use of increased revenue is also *unspecified*. To check whether the status quo effect has been adequately captured by the *zero*-dummy, we also estimate a model where all observations where *taxrise* equals zero are omitted (Model 3). The absolute sizes of the coefficients change slightly relative to Model 1, but it is actually only the relative sizes of the coefficients that have any meaning, and these change less than the absolute values. In summary, there seems to be a strong status quo effect in the results, but our model is able to adequately incorporate it.

As noted in Section 3, the conditional logit model relies on the assumption of Independence of Irrelevant Alternatives. We therefore test for violations of IIA using a procedure developed by Hausmann and McFadden (1984). They suggest that if a subset of the choice set is truly irrelevant, omitting it from the model will be inefficient but not lead to inconsistency. The test compares the model estimated with the full set of choice options with its counterpart after one particular option has been omitted. If the resulting chi-square statistic is greater than the critical value, the IIA assumption is rejected. We find that the IIA assumption is rejected at all conventional levels of confidence when either all alternatives where revenue use is unspecified are omitted, or when all alternatives where revenue is earmarked for environmental measures are omitted.

The violation of the IIA assumption is one reason to estimate a mixed logit model (Model 4). As mentioned in section 3, this model also has the additional advantages of accounting for the panel structure of the data and capturing preference heterogeneity. We specify a model where the coefficients for *environment* and *redistribution* are specified as normally distributed, in order to investigate the heterogeneity in preferences for earmarking. The rest are kept as fixed coefficients. The general pattern of results is the same as for the conditional logit models, with modest changes in the coefficients. Looking at relative sizes, the main changes are that the status quo effect is reduced slightly, and that the preference for earmarking for income redistribution is somewhat lower (compare model 4 to model 1 in table 3). The estimates of the standard deviations for the two random coefficients are highly significant and large relative to the mean. This suggests that respondents differ markedly in the extent to which they support earmarking. It also indicates that these coefficients take a negative value for a substantial share of the population implying a preference for unspecified revenue use rather than earmarking.

The absolute values of the estimated coefficients have no intuitive interpretation. However they can be used to derive a welfare measure of a policy change that is consistent with economic theory. We define the cost of a fuel tax policy to a representative voter as the increase in the tax rate. Now consider two policy proposals, policy 0 increases the tax some amount x with no earmarking, while policy 1 increases the tax by the same amount x with the additional revenues earmarked to a given cause. The amount by which the tax rate would have to increase in policy 0 over and above x in order to make the representative voter indifferent between the two policies is called the compensating variation (CV) for the earmarking. It can be calculated according to the following formula adapted from Hanemann (1984):

$$\text{CV} = \frac{V^1 - V^0}{b_{tax}} \quad (10)$$

where b_{tax} is the coefficient of *taxrise*, V^0 represents the utility of the tax rise of x with no earmarking, and V^1 represents the utility of the a tax rise of x with earmarking. If one assumes

utility is a linear function of the tax increase, the above equation simplified to the ratio of coefficients given in equation 11 where b_{ear} is the coefficient of the dummy variable for earmarking:

$$\text{---} \tag{11}$$

We will use this formula when comparing an earmarked increase with a non-earmarked increase. When comparing an earmarked tax rise with the status quo, we must account for the discontinuity in the utility function where the tax increase is zero. The formula then becomes:

$$\text{-----} \tag{12}$$

This formula estimates tax rise that would make the average voter indifferent between an earmarked increase and the status quo. Table 4 reports the compensating variations derived from the different models, both relative to a non-earmarked increase and relative to the status quo. Because the standard deviations cannot be calculated analytically, we use a parametric bootstrapping procedure developed by Krinsky and Robb (1986) to estimate 95% confidence intervals.

		taxrise ₀ =0		taxrise ₀ >0		
		Model 1	Model 4	Model 1	Model 3	Model 4
redistribution	Mean	-0.84	-0.78	0.75	0.69	0.34
	lower limit	-1.06	-1.03	0.57	0.48	0.11
	upper limit	-0.62	-0.54	0.94	0.88	0.57
environment	Mean	0.89	1.10	2.48	2.26	2.22
	lower limit	0.72	0.88	2.27	2.05	1.99
	upper limit	1.06	1.29	2.70	2.46	2.44

Table 4: Estimated compensating variations for earmarking when the alternative is zero tax rise and when the alternative is a positive tax rise.

As mentioned earlier, the ratios of coefficients are relatively stable across the different models. Because the mixed logit model is the most general model, we believe that it provides the most reliable estimates. The analysis suggests that the average voter would support a tax increase of up to around NOK 1.10 if the additional revenue were earmarked for environmental measures. This is a strong result since the respondents prefer lower taxes per se. In contrast, earmarking for income redistribution does not increase support enough to make any tax increase acceptable to the average voter. If government had decided to increase the fuel tax in any case (i.e. excluding the status quo effect), the results suggest that the average voter would be indifferent between a non-earmarked tax rise of a given amount and a tax rise around NOK 2.20 higher than that given amount with the additional revenues earmarked for environmental measures. Earmarking for income redistribution would only increase support to compensate for around a NOK 0.30 of a tax rise.

Results with the mixed logit model

The analysis so far has focused on average preferences. A richer picture can be obtained by taking preference heterogeneity into account. In contrast to the conditional logit model, the mixed logit model facilitates this type of analysis. Note that also within this model, average preferences have a particular salience. This is because we have assumed that the coefficients have independent and symmetric distributions, which means that the average preferences describes the median voter, whose preferences dictate which proposals can get a majority (Black, 1948). However, when making predictions about proposals that get a level of support different from 50%, preference heterogeneity becomes important. Figure 1 shows the predictions derived from the mixed logit estimation for the proportion of voters that would support a tax increase, as a function of the level of the tax increase and the use of revenues. Compared with predictions from the conditional logit model, the curves fall less steeply as the level of the tax rise increases. The figure illustrates for example that a tax increase of NOK 1 is predicted to garner support from 17% of voters when revenue use is unspecified, 29% when the additional revenues are earmarked for income redistribution, and 51% when the additional revenues are earmarked for environmental measures. The horizontal distance between curves illustrates which levels of tax rises would hold the level of support constant as revenue use varies. For example, the model predicts that a quarter of votes can be garnered either for a non-earmarked increase of NOK .34, for an increase earmarked for income redistribution of NOK 1.38, or for an increase earmarked for environmental measures of NOK 3.39.

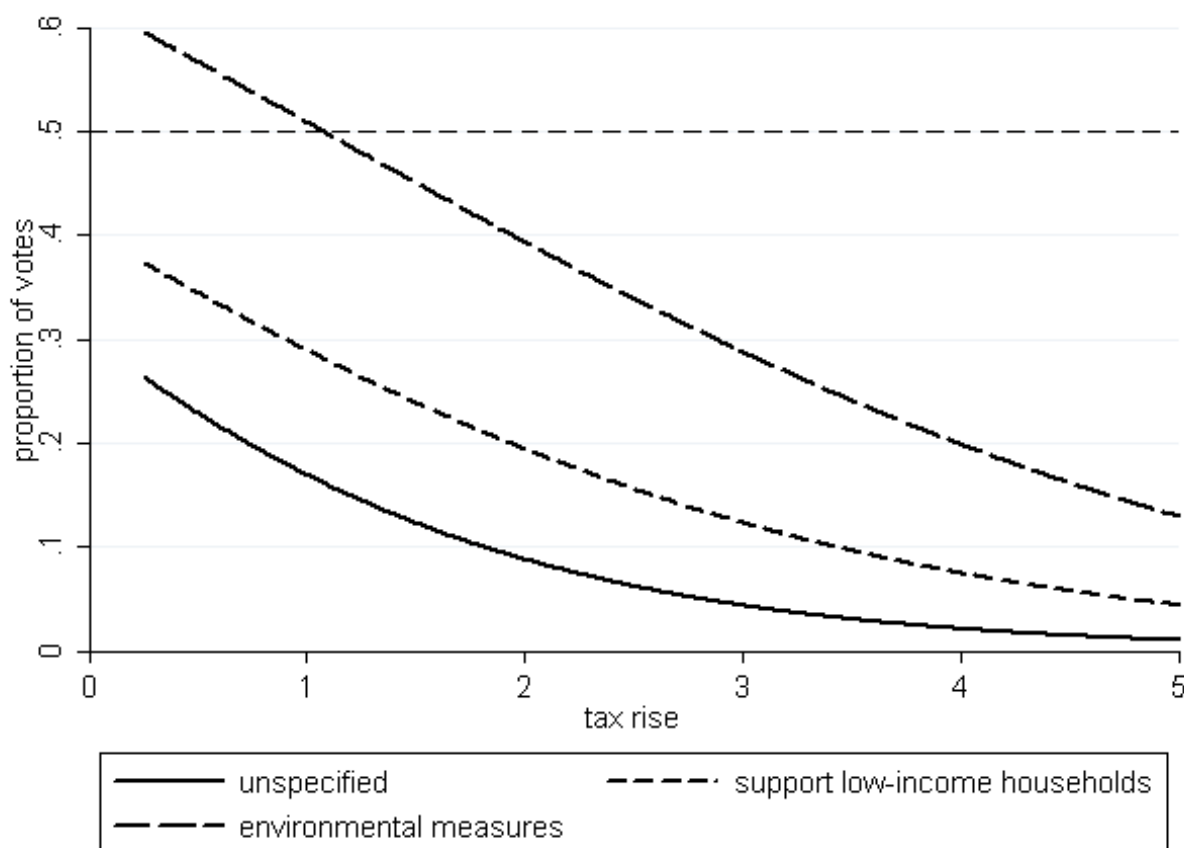


Figure 1: Predicted support for tax increases as a function of size of increase and use of additional revenues

Interactions with individual-specific variables

To test our hypotheses relating to research question 2 (why earmarking increases acceptability), we ran an expanded regression including a number of interactions between individual-specific attitudinal variables and the variables of the alternative tax policy proposals. The attitudes are measured on a 5-point likert scale. A dummy variable is created for each choice alternative, to be interacted with the dummy variables for revenue use. To avoid perfect colinearity, the middle category (*neither agree nor disagree*) is omitted and becomes the reference group. The first interaction is between earmarking for environmental measures and the extent to which individuals agreed with the statement that earmarking is crucial for the environmental effectiveness of the tax. It is interesting to note that most of the sample agreed with the statement, as can be seen from table 5. This shows that respondents either do not understand the substitution effect of the tax, or that they believe the price elasticity of demand for fuel is so low that a tax will not have much effect on behaviour. The interaction variables test whether these beliefs can explain the popularity of earmarking, as postulated in hypothesis 2C.

	Freq.	Percent	Cum.
Fully agree	570	48.43	48.43
Partly agree	374	31.78	80.2
Neither agree nor disagree	116	9.86	90.06
Partly disagree	64	5.44	95.5
Fully disagree	53	4.5	100

Table 5: “In order for fuel taxes to have an environmental effect it is crucial that the tax income [revenues] are earmarked for environmental measures.”

The coefficients of the interaction terms show that those who agreed with the statement have a stronger preference for earmarking for environmental measures than the reference group, and the difference is quite large and significant at the 1% level. This further strengthens the hypothesis 2C. There are no significant differences between those who disagreed and the reference group, but this may be largely due to the low number of respondents who disagreed.

The alternative hypothesis 2B that support for earmarking is motivated by distrust in government spending decisions is not supported by the regression results. Opposite to what this hypothesis predicts, those who distrust such decisions actually have a significantly lower preference for earmarking than the reference group. This is true for both types of earmarking.

Finally, we find a relatively consistent relationship between expected personal gain from earmarking and preferences for such, as predicted by hypothesis 2A. All the coefficients have the expected sign an ordering, and six out of eight coefficients are significantly different from zero at the 5% level. Hence part of the preference for earmarking seems to be motivated out of self-interest.

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<i>Attitudinal variable</i>	<i>Choice category</i>	<i>Attribute</i>	<i>Coefficient</i>	<i>t-value</i>	<i>p-value</i>
		taxrise	-0.595	-30.01	<0.001
		redistribution	0.539	4.32	<0.001
		environment	0.473	2.39	0.017
		zero	0.834	14.85	<0.001
"In order for fuel taxes to have an environmental effect it is crucial that the tax income [revenues] are earmarked for env. measures."	Fully agree	environment	0.608	4.01	<0.001
	Partly agree	environment	0.454	2.94	0.003
	Partly disagree	environment	0.006	0.03	0.976
	Fully disagree	environment	0.205	0.84	0.400
"The government makes reasonable use of the income [revenue] from taxes and fees."	Fully agree	redistribution	0.423	1.88	0.061
	Partly agree	redistribution	-0.028	-0.22	0.827
	Partly disagree	redistribution	-0.485	-3.71	<0.001
	Fully disagree	redistribution	-0.804	-5.22	<0.001
"The government makes reasonable use of the income [revenue] from taxes and fees."	Fully agree	environment	0.487	2.11	0.035
	Partly agree	environment	0.029	0.23	0.817
	Partly disagree	environment	-0.533	-4.29	<0.001
	Fully disagree	environment	-0.904	-6.20	<0.001
Would benefit personally from earmarking for environmental measures	Fully agree	environment	1.331	9.28	<0.001
	Partly agree	environment	0.349	2.35	0.019
	Partly disagree	environment	-0.271	-1.25	0.210
	Fully disagree	environment	-0.643	-2.42	0.015
Would benefit personally from earmarking for income redistribution	Fully agree	redistribution	1.586	11.51	<0.001
	Partly agree	redistribution	0.637	5.56	<0.001
	Partly disagree	redistribution	-0.298	-2.19	0.028
	Fully disagree	redistribution	-1.020	-7.36	<0.001
pseudo-R ²			0.34		

Table 6: Interaction effects from conditional logit regression

5 Conclusion

We have explored two research questions and tested five hypotheses. The first research question concerned how much earmarking can increase support for an increase in the fuel tax rate. We find support for both related hypotheses – that people prefer lower fuel taxes (H1A) and that earmarking increases public support (H1B). More specifically, our results suggest that there is a majority for increasing the current tax level by around 20% if the additional revenues generated are earmarked for environmental measures.

Our second research question concerns why earmarking increases public support for taxes. We tested three hypotheses relating to theories about why earmarking increases acceptability. We find support for the hypothesis that earmarking increases acceptability because people expect to benefit personally from the use of the earmarked revenues (H2A). We find strong support for the hypothesis that earmarking increases acceptability because people are concerned about the environmental effectiveness of the tax, and do not believe that the tax will improve environmental quality without earmarking (H2C). Those who do not understand that environmental taxes per se can improve the environment, show a stronger preference for earmarking. We reject, however, the hypothesis that earmarking increases acceptability of increased taxes because of distrust in government spending of revenues (H2B). Our results show that those who distrust the government do not favour earmarking more strongly than those who trust it, in fact they are significantly less in favour of it. Another illustration of this somewhat surprising result is that whereas earmarking for environmental taxes makes it acceptable to the majority to increase the fuel tax rate, earmarking for income tax does not, although it is still preferred over no earmarking. These two results combined suggest that the thematic link between taxing and spending is more important than the reduced uncertainty about what the revenues are spent on.

The study suggests that earmarking revenues for environmental purposes can be an attractive second-best policy option in the face of public opposition to environmental taxation. The reason seems to be that it raises the *perceived* environmental effectiveness of the tax. Whether this surprising result holds for other countries than Norway remains to be tested.

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Appendix: The questionnaire

This is a translation of the original Norwegian questionnaire. Some meaning is lost in translation. We have chosen a relatively direct (almost word by word) translation, but with further information or key words in square brackets where this direct translation could be misunderstood. We have preserved the original order of the questions, but some questions, which were not intended for nor used in this study are omitted. In addition to the questions asked in this questionnaire, we know from the Synovate web panel the respondents' age and location (big city, small city, village, or countryside). At the end of the survey the respondents had the opportunity to leave comments.

To what extent do you agree with the following statements:

- Increased fuel taxes will result in less [car] driving and lower emissions in Norway
- In order for fuel taxes to have an environmental effect it is crucial that the tax income [revenues] are earmarked for environmental measures.
- It is unfortunate if increased fuel taxes harm [negatively affect] people with low incomes.
- I will be dependent on driving [my car] in everyday life no matter how much better public transport becomes.
- The government makes reasonable use of the income [revenue] from taxes and fees.
- Where I live, there are good opportunities for using public transport to get to work, school, shops and leisure activities.
- Where I live, there are good opportunities for walking or cycling to work, school, shops and leisure activities.

Alternatives: Agree completely; Agree somewhat; Neither agree nor disagree; Disagree somewhat; Disagree completely.

Which of the following statements best represents your view?

Alternatives: Driving [a car] is a necessity for most people in Norway; Driving is a useful good, but not a necessity for most people in Norway; Driving is a luxury good for most people in Norway.

We would now like to explore how you react to different proposals for increasing the fuel

taxes, and what it means to you to know what the additional revenues would be spent on. In the next 8 questions we ask you to choose between different alternatives. The magnitude of the tax increase differs, and there are three alternatives for how the additional revenues can be spent:

- Unspecified, i.e. the revenues are used to pay for the governments general expenses or to reduce other taxes and fees.
- Earmarked for environmental measures, i.e. support for public transport, construction of walking and cycling paths, noise protection barriers and promoting environmentally friendly technologies.
- Earmarked for evening out income differences. The revenues are used to reduce the income tax so that the people with the lowest incomes benefit the most.

For the alternative “no change” to the tax there are no additional revenues to be spent. We ask you to tick the box for the alternative which you would prefer. There are no right or wrong answers. If you do not like any of the alternatives it is still important that you tick the box for the alternative which you are the least opposed to. You can always go back and change your answer if you change your mind (by using the back-button in the browser).

If you had to choose which alternative would you prefer?

Tax increase of X NOK per liter and additional revenues used for Y.

Tax increase of Z NOK per liter and additional revenues used for W.

[The alternatives for the magnitude of the tax increase were 0, 1, 2 and 4 NOK per liter]

Alternatives; Option A, Option B; I don't know.

To what extent are you concerned about the following consequences of car driving?

- That driving results in congestion on the roads
- That driving contributes to human made [anthropogenic] climate change
- That driving results in accidents injuring people
- That driving contributes to noise problems
- That driving contributes to local pollution which results in health problems

Alternatives: Very concerned; Somewhat concerned; A little concerned; Not concerned.

To what extent do you agree with the following statements: It would benefit me personally if the revenues from the fuel taxes were...

... used to pay for the governments general expenses or to reduce other taxes and fees.

... earmarked for environmental measures, i.e. support for public transport, construction of walking and cycling paths, noise protection barriers and promoting environmentally friendly technologies.

...earmarked for evening out income differences by reducing the income tax so that the people with the lowest incomes benefit the most.

Alternatives: *Agree completely; Agree somewhat; Neither agree nor disagree; Disagree somewhat; Disagree completely.*

What was the total income of your household before tax?

Alternatives; Less than NOK 100,000; NOK 100-199,000; NOK 200-299,000; NOK 300-399,000; NOK 400-499,000; NOK 500-599,000; NOK 600-799,000; NOK 800-999,000; More than NOK 1 million; I do not wish to answer this question; I do not know.

How many people aged 18 or more are there in your household (including yourself)?

Alternatives: *1; 2; 3; 4; 5; 6; 7; 8; 9; 10; More than 10.*

How many people under the age of 18 are there in your household?

Alternatives: *0; 1; 2; 3; 4; 5; 6; 7; 8; 9; 10; More than 10.*

If there was an election for the Storting [parliament] today, which party would you vote for?

Alternatives: *FrP (progress party); H (Conservative party), KrF (Christian democratic party), V (Liberal party), SP (Centre party), Ap (Labour party), SV (Socialist left party), Other party; I do not know.*

Does your household have daily access to a car?

Alternatives: *Yes; No.*

[Conditional on the previous question] In total, how many kilometers do you drive with the cars in your household and for which you pay for the fuel yourself (you might know this if you think about how many kilometers your cars are insured to drive per year)?

Alternatives: *open ended.*

[Conditional on the previous question] What is the fuel consumption in litres per 10 kilometers [the standard measure for fuel economy in Norway] for the car your household uses the most?

Alternatives: *Less than 0.5 litres per 10 kilometers; Between 0.5 and 0.75 litres per 10 kilometers; Between 0.75 and 1 litre per 10 kilometers; More than 1 litre per 10 kilometers; I do not know.*