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Public accept for environmental taxes: self-interest, environmental and distributional concerns

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Sammendrag:.Samtidig som økonomer har anbefalt å innføre avgifter for å sette en pris på eksternaliteter, har det ofte vist seg politisk vanskelig å innføre slike avgifter. Det finnes en stor litteratur om holdninger til miljøavgifter. Det har imidlertid vært få forsøk på å sette disse i sammenheng og på å isolere effekten av egoistiske og sosiale preferanser.

Forskningsspørsmålet i dette studiet er hvilke faktorer som påvirker oppslutningen om drivstoffavgiftene. Vi introduserer en modell for holdninger til drivstoffavgifter og tester denne modellen samt mer spesifikke hypoteser ved hjelp av data fra en spørreundersøkelse foretatt blant et representativt utvalg av den voksne norske befolkningen.

Våre resultater antyder at oppslutningen om drivstoffavgiftene best kan predikeres basert på oppfatninger av miljøkonsekvensene (av avgiften), fulgt av oppfatninger av konsekvenser for andre mennesker. Opfattningen av konsekvenser for en selv (egeninteresse) er den faktoren som forklarer minst av variasjonen i oppslutningen om drivstoffavgiftene.

Det faglig interessnate funnet at oppslutningen ikke kan forklares godt uten å fange opp et bredt spekter av motivasjonsfaktorer er også høyst politisk relevant. Funnet indikerer at det ikke finnes noe magisk formular for å øke oppslutningen om miljøavgifter. Det er imidlertid noe faktorer der er mulig å gjøre noe med: tilliten til hvor godt myndighetene bruker provenyet, og oppfatningen av at avgiften i seg selv ikke påvirker atferd eller gir noen miljøforbedring.

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Abstract: While strongly recommended by economists, it has often been politically difficult to impose taxes on externalities. There is a substantial literature on public attitudes towards environmental taxes. There have, however, been few comprehensive attempts to understand attitudes towards environmental taxes, and few attempts to isolate the effects of selfish and social preferences.

The main research question in this paper is which factors influence support for fuel taxation. We propose a model of attitudes towards fuel taxation, and test this model as well as more specific hypotheses, using data from a representative survey of the adult Norwegian population.

Our results suggest that support for fuel taxation is best predicted by beliefs about environmental consequences, followed by beliefs about consequences to others. Beliefs about consequences to self (self-interest) is the factor that explains the least variation in support for fuel taxation.

The academically interesting result that support cannot be well explained without capturing a broad range of motivational factors is also highly policy relevant. It implies that there is no magic formula for increasing public support for environmental taxes. There are, however, some issues which can be addressed: trust in how well the government spends the revenue, and the perception that taxation does very little to change behaviour and thus to reduce environmental problems.

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1 Introduction

Two things in life are supposedly certain: death and taxes. It might be certain that there will be taxes, but it is far from certain what will be taxed – and how much. While strongly recommended by economists, it has proven politically difficult to impose efficient Pigouvian taxes (i.e. taxes on externalities) because of opposition from both industry and the public. There are many examples of failed Pigouvian tax initiatives, such as the French carbon tax in 2010, road pricing in Edinburgh in 2005, a tax on fossil fuels in Switzerland in 2000, the fuel tax escalator in the UK in 1999, or the tax on energy in the US in 1993, to name just a few examples. Opposition to Pigouvian taxation comes from both businesses and the public. The main motivation for this study is to better understand the factors that influence public support for Pigouvian taxation, and what can be done to make Pigouvian taxes more feasible.[1]

In this paper we present a model of public support for Pigouvian taxes, provide testable hypotheses, and use survey data to assess these hypotheses. We proceed with a review of the literature in section 1. We introduce the model and our hypotheses in section 2. We describe the survey and analyze the results in section 3. Finally, we give our concluding remarks in section 4.

2 Support for Pigouvian taxes: literature review

It is not straightforward to define what constitutes a *"*feasible" tax. It is simple only in the relatively rare situations when binding public referenda are held on the introduction of new taxes, although this was the case with the Swiss referendum on fossil fuel taxes in 2000 (Thalmann, 2004). In representative democracies, a politically feasible tax is a tax that generates enough votes in the parliament, congress or senate. In practice it is often difficult to describe exactly what is necessary for a tax proposal to be politically feasible. Businesses and special interest groups clearly have a strong influence. There are many theories that can explain the political opposition to taxes imposed on industries, among them public choice theories on rent seeking and special interest groups. These theories suggest that small interest groups with much at stake will be most effective in influencing government policy (Olson, 1965).

While the household opposition to a tax proposal might typically be less well organized and funded than that of industries, households hold significant political power because they vote. Gaunt and his co-authors (2007) argue that for road user charging "commentators now acknowledge that the greatest impediment to implementation is public … acceptability". This supports the argument that at least for taxes levied directly on individuals, public support is essential to make a tax feasible. King et al. (2007) does not agree fully, and argues that "the idea that a policy cannot be approved in the absence of popular support is at odds with the way policies are actually advanced." Although the "political calculus" of environmental taxes might not be an exact science, it is still clear that it is politically risky to propose unpopular policies. List and Sturm (2006) find that "while lobby contributions [from industry] must undoubtedly be an important factor behind policy choices in many areas, it seems difficult to deny that politicians implement policies […] also to attract additional voters to their platform."

Models of support for environmental taxes

Among the studies on the support for Pigouvian taxes, very few are based on a theoretical model. Most studies are either exploratory – such as focus group studies attempting to identify which factors matter, experiments designed to test the effect of one or a few factors in isolation, or (the largest

[1] The terms "support" and "acceptability" are used interchangably in this paper.

group) survey analyses based on more or less ad-hoc assumptions. Three important exceptions are the papers by Stern et al. (1993), Rienstra et al. (1999) and Schade and Schlag (2003):

Stern et al. (1993) provides a widely used theoretical foundation for explaining proenvironmental behaviour. They develop a social-psychology model where action in support of environmental quality can be motivated by egoistic, social-altruistic and biospheric value orientations. They go on to test the model using survey data. While they find general support for their model, they also find that when it comes to the willingness to pay through taxes, only self-interested motives are a reliable predictor.

Rienstra et al. (1999) create a conceptual framework to assess the feasibility of various transport policies. The framework has three main categories of factors explaining support for policy measures: Personal features and current mobility pattern, perception of the effectiveness of policy measures, and perception of mobility as an individual/social problem.

Schade and Schlag (2003) use a "heuristic acceptability model" to identify and analyse determinants of the acceptability of road pricing. The model includes eight different factors: problem perception, aims to reach (e.g. financial, ecological), mobility related social norms (do your significant others think you should accept the strategy), knowledge about options, perceived effectiveness and efficiency of measures, personal outcome expectations, attribution of responsibility (to self or to others), and socio-economic factors. They find that the factors *social norm*, *personal outcome expectation* and *perceived effectiveness* are positively related with acceptability, and that these factors explain acceptability much better than the socio-economic variables they included.

Factors influencing support for environmental taxes

Among the papers that focus on identifying which factors influence support for taxation (rather than develop and test a model thereof), the results are relatively consistent. One important reason for public opposition to environmental taxes is that the public does not seem to understand – or trust – the main rationale for Pigouvian taxes. Dresner et al. (2006a) find that both the general public and business hold "a view of taxes solely as a means of raising revenue, rather than in terms of their incentive effects". It seems that people to a large extent do not understand how a tax can increase welfare (see also Kallbekken et al., 2008), and furthermore that they do not believe taxes to be very effective in influencing behaviour. In partial contradiction to this, Kallbekken and Aasen (in press), find that most participants in a focus group study in Norway thought that the "main purpose of environmental taxes was to influence behaviour (provide incentives to substitute away from the polluting activity), rather than to raise revenue for the government". The majority of studies is, however, in line with what Dresner and his co-authors found. Gaunt et al. (2007), analyzing the rejection of the Edinburgh road user charge, find that "the public were largely unconvinced that the scheme would have achieved its dual objectives of reducing congestion and improving public transport." Putting it quite simply: people typically do not believe that the price (or tax) elasticity of the taxed good is very high.

This result can be linked to the strong and consistent result that earmarking the revenues from environmental taxes for environmental purposes increases their popularity: if you do not believe that environmental taxes will improve the environment by altering behaviour, then earmarking the revenues for environmental purposes might do the trick. Another important reason for the strong support for earmarking might be public distrust in government. Rivlin (1989) made the general 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". The result that earmarking the revenues would substantially increase support seems very robust and is confirmed by Dresner et al. (2006b), Hsu et al. (2008), Schade and Schlag (2003), Schuitema and Steg (2008), Steg et al. (2006) and Thalmann (2004).

One drawback of these studies is that while they can say how much support for a specific tax scheme would increase if the revenues were earmarked; they are unable to generate more generalized results or say much about which factors influence how much earmarking increases support. Using a choice

experiment design Sælen and Kallbekken (2010) estimate the gain in support produced by earmarking the (additional) revenues for environmental measures. Without earmarking the majority of the people would prefer to reduce the current tax rate by around 20 %, whereas Sælen and Kallbekken find that with earmarking the majority would prefer to increase the tax rate by about 20%.

Several focus group studies find that people would generally like more information about the environmental taxes (e.g. Dresner et al., 2006a). While these studies come out in favour of providing information in order to increase support, Winslott-Hiselius et al. (2009) draw a somewhat different conclusion based on the experiences with the Stockholm congestion charge. They suggest that "trials, generally, may be a more useful tool than information in the process of implementing 'difficult' policy measures, such as congestion charges" (Winslott-Hiselius et al., 2009).

Two issues relating to fairness have been identified as having an effect on the support for policy instruments: the perceived distributional fairness of the tax (see Dresner et al., 2006a; Eriksson et al., 2006; Fujii et al., 2004), and the coerciveness of the instrument (see Baron and Jurney, 1993, Jakobsson et al., 2000).[2] Taxes on some externalities, for instance emissions associated with energy intensive goods, can be regressive (e.g. Shammin and Bullard, 2009). Again the issue of how the revenues are used is central: Eliasson and Mattsson (2006) find that for the equity effects of the Stockholm congestion charge, the two most important factors are the initial travel patterns and how revenues are used. In addition to distributional concerns, there has been significant attention dedicated to the resistance to coercive policies. Baron and Jurney (1993) find that people would vote against policy reforms which they expected to produce net benefits if they perceived the policies to be coercive. They suggest that one reason why there are social norms against voting for coercive policies is that such policies take away choices from people. This is confirmed by for instance Jakobsson et al. (2000), who find that the acceptability of road pricing is "negatively affected by perceived infringement on freedom". A related finding in Kallbekken and Aasen (in press) is that some focus group participants "thought it would be unfair to impose a tax if there are no environmentally friendly alternatives, and others do not see the point of environmental taxes if they have no effect on behaviour (i.e. if the tax elasticity is low)."

In addition to the factors discussed thus far, it is also possible to relate attitudes to environmental taxes to broader socio-economic and political variables. Income, age, sex and pro-environmental attitudes are among the significant factors identified by Eriksson et al. (2006), Fujii et al. (2004), Jakobsson et al. (2000) and Loukopoulos et al. (2005). Rienstra et al. (1999) find that that support is higher among older people, people with a higher education, those who do not own a car, and members of higher income groups.[3] Analyzing survey results from a Swiss referendum on fossil fuel taxes, Thalmann (2004) finds that the main determinant of the vote was people's political orientation, that people with a higher education voted significantly more often in favour of the tax proposals, while household income was not a clear-cut determinant, and gender had no effect. Furthermore, citizens living in the largest municipalities were more favourable towards the tax proposals, as were people with more faith in government regulation than in the self-regulation of markets. People who owned a car were markedly less favourable towards the proposals.

3 A model of support for environmental taxes

The existing literature provides a rich background for identifying factors which influence public support for fuel taxes (environmental taxes in general). The reason for conducting another survey is that there are important weaknesses with the existing research on this topic. The most important weakness is that most studies approach the issue in an ad-hoc manner, often focusing on how one or a few factors influence support. Stern (2000) argues that in order to understand environmentally significant behaviours better, we need theories or models that incorporate variables from more than

[2] Kallbekken and Aasen (in press) find that potentially undesirable distributional effects of taxation did not seem to be as important for participants in a Norwegian focus group study, as it seems to have been in other studies.

[3] There is least support in the lowest income group, but no significant differences among the other groups.

one of the different classes of models. We agree with this claim and propose a comprehensive model that accounts for the influence of different types of factors on the support for fuel taxes. Based on this model we present clear and testable hypotheses. Furthermore, we address the literature gap identified by Jaensirisak (2005) – that there have been few attempts to isolate the impacts of selfish and social preferences – by assessing the relative impact of these different factors on support for taxation.

The model proposed by Stern et al. (1993) provides a useful point of departure for explaining attitudes towards fuel taxes. There are also other relevant models of proenvironmental or prosocial behaviour (e.g. Ajzen, 1991, Schwartz, 1977). Some, but not all of these models can be extended to predict support for environmental taxes. When it comes to addressing our research question, we need to account for how support for environmental measures relates to attitudes towards taxation as a policy instrument per se (i.e. trust in government use of revenues, substitution effects and income effects). We build on insights from existing (general) models and propose a specific model designed to account for attitudes towards both the environmental issue and towards taxation as a policy instrument.

We propose that an individual's level of support towards environmental taxes is influenced by four broad factors. The first is the individual's perception of the consequences of the tax to herself. The second factor is the individual's perception about the environmental consequences of the tax. The third is the individual's perception about the consequences of the tax to other people. Lastly, we include socio-political variables.

For the purposes of this paper we further propose specific variables which can be used to represent the factors in the model, as shown in table 1.

Overarching factor	**Specific variable**
Beliefs about consequences to self	fuel consumption, daily access to car, household income, availability of alternative transport
Beliefs about environmental consequences	concern about environmental effects of driving, perceived effect of tax on emissions from cars
Beliefs about consequences to others	concern for regressive effects of the tax, perceived income elasticity of demand
Socio-political variables	trust in government use of revenues, gender[4], education

Table 1: The relationship between overarching factors and specific variables in the model

We define the following general model of support for fuel taxation, where the explanatory variables refer to the factors listed in Table 2: Support = f(fuelconsumption, income, alternatives, env.concern, effectiveness, regressive, incomeelasticity, political, trust, gender, education)

The levels of the explanatory variables are elicited through the various questions in the survey (the survey questions can be found in the appendix). Apart from fuel *consumption* and *income,* they are categorical variables. Table 2 lists the different questions together with the answer alternatives, which are numbered for later reference. It also states our hypothesis about which category we expect to be most (least) supportive of fuel taxation, notated with the sign "+" ("-"). For the continuous variables, signs denote the hypothesized sign of the marginal effect of an increase in this explanatory variable on support. The hypotheses are numbered from H1 to H10. They are based on our model and on existing literature.

[4] Gender is included as Stern (1993) find that women are more likely support pro-environmental political action, though the effect disappears when beliefs (values) are controlled for.

Label	**Question/Statement**	**Alternatives**	
fuelconsumption	Total annual fuel consumption	Continuous -	H1
income	Gross annual household income	Continuous +	H2
alternatives	Self-reported possibilities for… a) …walking or bicycling instead of driving b) …using public transportation	Poor- to good+ (1 to 5)	H3
env.concern	Concern for the effects of driving… a) …on the climate b) …on local air quality c) …in terms of noise d) …in terms of congestion e) …in terms of accidents and injuries	None- to high+ (1 to 4)	H4
effectiveness	Perceived effectiveness of taxes at reducing car use and emissions	None- to high+ (1 to 5)	H5
regressiveness	Concern for the effect of fuel taxes on low-income households	None+ to high- (1 to 4)	H6
incomeelasticity	Perception of driving as a necessity or luxury	Necessity- to luxury+ (1 to 3)	H7
trust	Trust in government use of tax revenues	Low- to high+ (1 to 5)	H8
gender	Gender	male-, female+	H9
education	Highest level of education completed	9 yrs– to >4 yrs university+ (1 to 4)	H10

Table 2: Explanatory variables in the model, questions in the survey and hypotheses

In order to estimate the model empirically, it needs to be specified more precisely than the conceptual model above. For each categorical variable, *k* dummy variables are created, where *k* is the number of categories. These are named by combining the label and the category number from table 2. For each dummy-coded variable, one of the dummy variables is left out of the model to avoid perfect colinearity. For the attitudinal questions with four (five) alternatives, alternative 2 (3) is omitted. For gender, the omitted group is *male.* An error term *e* is included to account for the variance in support not explained by the model. The model to be estimated empirically hence becomes:

$$S_i=\beta_1 \text{fuelconsumption}_i + \beta_2 \text{income}_i + \delta_{1d}\text{alternatives.a}_{di} + \delta_{2d}\text{alternatives.b}_{di} + \delta_{3d}\text{concern.a}_{di} + \delta_{4d}\text{concern.b}_{di} + \delta_{5d}\text{concern.c}_{di} + \delta_{6d}\text{concern.d}_{di} + \delta_{7d}\text{concern.e}_{di} + \delta_{8d}\text{effectivness}_{di} + \delta_{9d}\text{regressivness}_{di} + \delta_{10d}\text{incomeelasticity}_{di} + \delta_{11d}\text{trust}_{di} + \delta_{12}\text{female}_i + \delta_{13d}\text{education}_{di} + e_i$$

where the subscript *d* denotes a dummy variable from 1 to *k*, while the subscript *i* denotes the individual.

The equation above is not a regression model because the level of support *S* is not directly observable. Our observations are limited to the respondents answer to the question: "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?" For simplicity we will hereafter refer to this as the "referendum". The respondents can choose between five alternatives: remove the taxes, decrease the taxes by NOK 1/litre, no change, increase the taxes by NOK 1/litre, and to double the current tax rates. We denote the outcome by y_i. This variable is ordinal: the alternatives have a natural ordering from one to five, but the numerical values reflect only the ordering and have no other numerical meaning. This makes the usual linear regression inappropriate. Instead, we use an ordered choice model. We assume that the larger the latent variable *S,* the more likely a higher ranked alternative will be chosen. Specifically, we assume respondents will make their choices based on comparing their *S* with certain threshold values, as illustrated in figure 1.

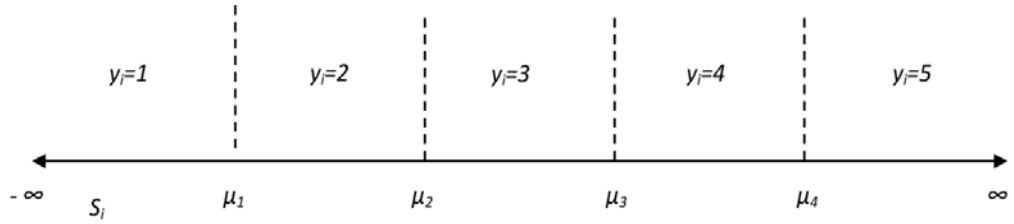

Figure 1: The latent variable S and threshold values.

By assuming that the error term is i.i.d. normal, we can apply the ordered probit model to estimate the coefficients in the equation for *S,* as well as the threshold values μ_i. This maximum likelihood estimation is carried out with numerical methods using the software Stata.

In addition to the factors included in the model, we expect attitudes towards fuel taxation to be correlated with political party preferences. We therefore elicit voting intentions for parliamentary elections. However, we do not include this variable in the model, as the direction of causality is ambiguous. Attitudes to fuel taxation may have causal influence on voting intentions. In that case, including voting intentions in our model would introduce the problem of reverse causality, which is a form of endogeneity that can result in biased empirical estimates. Another possibility is that both attitudes to fuel taxation and political preferences are partly explained by some underlying attitudinal variable which is not observed. If so, any relationship identified between the two observed variables would to some extent be spurious, again resulting in biased estimates. We therefore leave political preferences out of the model, but we will present descriptive statistics about their relationship with attitudes to fuel taxation, as this may be of interest regardless of the causal nature of the

relationship. Our hypothesis relating to political party preferences is that Support is higher among people who would vote for the social democratic parties than for people who would vote for the conservative parties (ordered according to the traditional left-right axis in Norwegian politics), and lowest for people who would vote for the Progress party.

There might still be some issues with endogenity in the estimated model. It has been suggested (for instance by Rienstra et al., 1999) that due to cognitive dissonance, people who do not want taxation, might answer that they do not believe that taxes will be very effective in influencing behaviour. It may also be that strong opposition to fuel taxes can cause people to reduce their (stated) concern for the environmental effects of driving, again to reduce cognitive dissonance. In other words, it is not given that the chain of causation is always in the direction implicit in our model. While we cannot rule out that cognitive dissonance can affect the direction of causality, we consider the direction implied in our model to be the most standard and most plausible direction of causality. Endogeneity is a potential problem in general when attitudinal variables are used as predictors. This may be a part of the reason why several studies (including Schade and Schlag, 2000, and Jaensisirak et al., 2005) find that attitudinal factors explain more of the variation in acceptability than socio-economic factors do.

4 Results and discussion

In March 2010 we conducted a nationwide online survey of the adult Norwegian population. The survey was conducted by the survey company Synovate. 1245 people responded to the invitation to take part in the survey, out of which 1177 people completed the survey (we excluded the data from the people who began but did not complete the survey). The median time taken to complete the survey was 8 minutes. The response rate was 45% and the sample was representative of the adult Norwegian population with respect to age, gender and region.

Before interpreting the results, it is important to know that Norway has had a tax on petrol since 1933 and on diesel since 1991. The purpose of these taxes is to make users face the external costs related to accidents, congestion, noise, road wear and emissions with negative health and environmental impacts (Ministry of Finance, 2010). In addition, there is a CO_2 tax on both petrol and diesel. In 2010 the total tax rate was NOK 5.40-5.44/litre for petrol and 4.14-4.19/litre for diesel. Using NOK 5 as an approximation (this was the number used in the survey) this corresponds to around EUR 0.60/litre or USD 3.20/gallon.

4.1 Descriptive results

The most important question in the survey and the dependent variable in our analysis is the referendum. Table 3 shows the distribution of the answers to this question

.

	N	*Percent*	*Cumulative Percent*
Remove the taxes (i.e. reduce the tax by around NOK 5 per litre)	293	24.9	24.9
Reduce the taxes by NOK 1 per litre	358	30.4	55.3
No change to the tax rate	375	31.9	87.2
Increase the taxes by NOK 1 per litre	97	8.2	95.4
Double the fuel taxes (i.e. increase the taxes by around NOK 5 per litre)	54	4.6	100.0
Total	1177	100.0	

Table 3: Descriptive statistics for the referendum on the fuel tax rate.

The results clearly show that the majority of the respondents (55.3%) would want to reduce the fuel taxes. Only 12.8 % would like to increase the current fuel tax rates. Note that the question does not say anything about how the revenues would be used if the tax is increased - or how the drop in revenues would be compensated if the tax is decreased. As mentioned earlier, the effect on acceptability of how the revenues are used is the main topic in the paper by Sælen and Kallbekken (2010). In this paper the research question is how individual attributes such as car ownership, income and attitudes influence acceptability.

4.2 Estimating the model

We first ran an ordered probit model including all the variables from the equation on page 6. This estimation failed to identify a significant effect at the 5% level for some of the hypotheses presented in table 2. We first discuss these variables, before we present the results of a reduced model where these are left out. The most surprising non-effect is perhaps that the availability of alternative means of transportation does not have significant predictive power. The regression also fails to identify any significant influence of several categories of concern for the environmental consequences of driving. In fact it is only the concern for climate change that seems to have any significant effect. This is partly because correlations between concern for the different effects of driving make it difficult to isolate the effects of each. If the variables measuring concern for the climatic consequences are omitted, some of the dummy variables relating to concern for local pollution effects become significant. Nevertheless, the result contrasts with the Ministry of Finance's stated motivation for the fuel tax (estimated external effects). The CO_2-tax only makes up 14-16 percent of the total tax rate on fuels. *Education* is highly correlated with *income*, and its coefficients are not significant when *income* is also included.

The rest of the variables are included in a reduced model, the results of which are given in Table 4. The number of observations used in this estimation is 1080, as 97 respondents did not disclose their income. The standard measure for the goodness of fit for ordered probit model is the likelihood-ratio index, also known as McFadden's pseudo R^2, which is given by

$$1 - \frac{\mathrm{LL}(b)}{\mathrm{LL}(0)}$$

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 model obtains a value of .22, which is reasonably high for this type of model. The coefficients can be interpreted as the marginal effects on the latent variable *Support*. Although the absolute level of this variable has no interpretation, it is nevertheless useful to compare the relative sizes of the coefficients and their signs. The coefficients for fuel consumption measures the marginal effect on *Support* of an increase in fuel consumption of 100 litres, and the corresponding unit change for income is NOK1000. For the dummy coded variables, the change is from 0 to 1, i.e. the marginal effect on Support of being in a given category relative to the reference group (the omitted category). Marginal effects relating to the observed dependent variable – the alternative chosen in the referendum – can be calculated in the form of marginal effects on the probability of choosing each of the five alternatives. For the sake of brevity, these are not reported here. Intuitively it is clear that a positive coefficient translates into a positive marginal effect on the probability of selecting one of the higher alternatives. As a point of reference we note that a high degree of environmental concern means a 13% increase in the probability of supporting a tax rise, relative to the reference group (some concern).[5]

[5] Based on a simple probit where the dependent variable is collapsed to increased tax versus non-increased tax.

Variable	*Coef.*	*Std. Err.*	*p-value*
fuelconsumption	-0.0064	0.0024	0.009
income	0.0004	0.0002	0.048
env.concern.a1	-0.3602	0.0983	0.000
env.concern.a3	0.3564	0.0883	0.000
env.concern.a4	0.6220	0.1132	0.000
effectiveness1	-0.5339	0.1299	0.000
effectiveness2	-0.1929	0.1207	0.110
effectiveness4	0.2886	0.1234	0.019
effectiveness5	1.0285	0.1780	0.000
regressivness1	0.0580	0.1868	0.756
regressivness2	0.4679	0.1580	0.003
regressivness4	-0.0881	0.1090	0.419
regressivness5	-0.5631	0.1111	0.000
incomeelasticity1	-0.2950	0.0797	0.000
incomeelasticity3	0.6455	0.3434	0.060
trust1	-0.5109	0.1260	0.000
trust2	-0.1217	0.1001	0.224
trust4	0.3504	0.0998	0.000
trust5	0.5802	0.1800	0.001
female	-0.2256	0.0712	0.002

Table 4: Estimated coefficients, standard errors and p-values for the reduced model

The table of coefficients reveal several interesting findings. We first note that the variables in the group *consequences to self* (fuel consumption, car access, income, alternatives) have little predictive power for *Support.* Although the coefficients for *income* and *fuelconsumption* are significantly different from zero at the 5% level, their magnitude is small. To yield a difference in support comparable to the marginal effects of the dummy variables, the change in *income* would have to be in the order of magnitude of NOK 1 000 000, while the equivalent figure for *fuelconsumption* is 10 000 litres. Furthermore, as we have seen, the variables relating to the availability of alternative modes of transport were dropped because of lack of significant coefficients.

The coefficients for the different groups of concern about the climatic effects of driving are all highly significant, have the expected signs and relative sizes, and their absolute magnitudes are large compared to other variables. The same applies to the categories of the perceived effectiveness of fuel taxes at lowering emissions, except that the coefficient for one of the intermediate groups is not quite significant. One may combine these observations to conclude that the extent to which people perceive fuel taxes to have an effect on the climate has considerable predictive power for *Support.* The variables constituting the group *Perceived consequences to others* can also explain some of the variance in *Support*. Starting with the coefficients for the *regressiveness* dummies, we see that the signs and the ordering is as hypothesized: *Support* decreases as the concern for the regressive effect of the tax increases. However, only two of the coefficients are significantly different from zero at the 5% level, which means that the relationship is not very robust. Moving on to the perceived income elasticity of demand, we note that perceiving car use as 'a necessity for most people' has a significant negative effect on support, compared with the reference group who thought car use

was best described as 'a useful good but no necessity'. The coefficient for group 3 – who perceived car use as a luxury, is positive and quite large in magnitude. This effect is, however, marginally not significant at the 5% level due to the low frequency for this alternative – only 15 respondents chose this alternative.

The *Socio-political variables* add further predictive power to the model. The variable - trust in government - appears to be one of the most important predictors of *Support,* with *Support* increasing monotonically with increases in *trust.* The coefficients are relatively large, and significantly different from the reference group, except for one of the intermediate levels of trust. The most surprising effect obtained in the regression is perhaps the negative and significant coefficient for *female,* which is the opposite of the effect we had hypothesised. The difference between the two genders is not very large or even unambiguous when cross tabulating gender with answers in the Referendum (see table 5). Hence the effect of gender primarily arises when controlling for the other factors included in the regression. We would not draw strong conclusions from this result.

	% within Female	*% within Male*
Remove the taxes (i.e. reduce the tax by around NOK 5 per litre)	24.5	25.3
Reduce the taxes by NOK 1 per litre	33.3	27.5
No change to the tax rate	28.0	35.7
Increase the taxes by NOK 1 per litre	7.9	8.6
Double the fuel taxes (i.e. increase the taxes by around NOK 5 per litre)	6.3	2.9

Table 5: Contingency table for gender and Support.

The relationship between political party preference and *Support*, which was omitted from the model for reasons discussed above, is presented in the cross tabulation in table 6. To test for associations between the two variables, we apply a series of Chi-square tests. For each cell in row *i* and column *j*, we create a 2X2 contingency table where one dimension has the categories *Row i* and *Not row i,* and the other dimension has the categories *Column j* and *Not column j.* We test the null hypothesis that the two variables *Row i – Not row i* and *Column j – Not column* j are independent by comparing the expected contingency table when this hypothesis is true with the observed contingency table. We apply a standard Pearson's chi-square test statistic. The cells for which the null hypothesis is rejected at the 1% confidence level are marked, with ▲where there is a positive association and ▼where there is a negative association. Two political parties stand out as significantly different from the rest. On one side of the political spectrum, Progress party voters are least supportive of fuel taxes, while at the other side the Socialist Left party voters are most supportive. The Conservative party trails the Progress party in opposition, while Labour party voters display a fairly high degree of support. All of these results are as expected given the manifestos of these parties. There is a positive association between the group *Other* and the highest category of support. A plausible explanation for this is that most likely a large share of the supporters of the Green Party and the (left-wing party) Red can be found in this group.

If there was a parliamentary election today, which party would you vote for?										
	Total	**FrP**	**H**	**KrF**	**V**	**SP**	**AP**	**SV**	**Other party**	**Don't know**
No. of interviews	1177	161	271	43	54	51	254	100	36	207
Remove taxes	25 %	61%▲	20 %	14 %	7 %▼	10 %	15 %▼	4 %▼	25 %	36 %▲
Reduce by NOK 1	30 %	29 %	40%▲	40 %	28 %	39 %	27 %	8 %▼	17 %	33 %
No change	32 %	9 %▼	35 %	28 %	43 %	37 %	43 %▲	45%▲	17 %	26 %
Increase by NOK1	8 %	1 %▼	3 %▼	7 %	15 %	8 %	13 %▲	29%▲	17 %	3 %▼
Double taxes	5 %	▼	3 %	12 %	7 %	6 %	3 %	14%▲	25%▲	2 %

Table 6 : Contingency table for political party preference and Support (column percentages, Chi-square tests with 1 % confidence intervals)

The regression model suggests that the overarching factor that best predicts *Support* is *Beliefs about environmental consequences,* while *Beliefs about consequences to self* is the factor that explains the least variation in *Support.* To pursue this lead, we create four different regression models, one for each of the overarching factors, with all the variables in table 2 included in one and only one model. We can compare the models' goodness of fit using the likelihood ratio indexes. The results are reported in table 7. Note here that pseudo-R^2 does not have the same intuitive interpretation as R^2 from an ordinary least square regression. Nevertheless, when comparing two models estimated on the same data so that they have the same LL(0), it is usually valid to say that the model with the highest log likelihood ratio fits the data better (Train, 2003)

Explanatory factor included	**Likelihood ratio index (pseudo-R^2)**
Beliefs about consequences to self	0.05
Beliefs about environmental consequences	0.17
Beliefs about consequences to others	0.10
Socio-political variables	0.08

Table 7: Likelihood ratio index for the four overarching factors

These results corroborate the observations based on the main model. This study therefore suggests that the standard economic model of self-interested behaviour is not well-suited for explaining voting intentions on the issue of fuel taxation.[6] It is *Beliefs about environmental consequences*, followed by *Beliefs about consequences to others*, that provide the most explanatory power. Our results thus suggest that people's voting intentions are more closely linked to environmental and altruistic motivations than they are to selfish motivations. This contradicts the findings from several other studies. Stern et al. (1993), for example, find that only self-interested motives are a reliable predictor of support, whereas we find (narrowly defined) self-interested motives to be the least reliable predictor. This could be an indication that attitudes towards taxation differ significantly between the USA (where Stern et al. conducted their survey) and Norway. However, it is also interesting to note some results that partially contradict the findings from the focus group study which this survey was partially based on (Kallbekken and Aasen, in press). The variable "availability of alternative transport" was included because this seemed to increase the level of support for environmental policy instruments in general. This variable did, however, not have significant predictive power in our model. Finally, while they found that "undesirable distributional effects of the taxes do not seem to have been as important for the Norwegian participants, as it seems to have been in other studies", the estimated coefficients in our model partially contradict this result too.

5 Concluding remarks

Fuel taxes are not popular. Our survey results suggest that the majority of the Norwegian population would like to decrease the current fuel tax rates by 20 % or more. This is not a very surprising finding. What is more surprising are the main motivations behind this fuel tax opposition: the economist view that voting intentions can best be explained by self-interest performs rather poorly when in comes to explaining voting intentions in our survey. We find that support is best predicted by beliefs about environmental consequences, followed by beliefs about consequences to others.

If the objective is to increase voter support for fuel taxation, it is important to ensure that people understand and believe that fuel taxes will have positive environmental consequences. More specifically this would mean (1) to communicate the relationship between driving and climate change and (2) to communicate the effectiveness of taxes in influencing emissions from cars. Regarding the first causal link, education and information about the science of climate change may yield positive results in terms of support, as there appears to be a wide gap between scientists' and the public's perception of climate change. Yet, it is a challenging task to communicate the scientific consensus to the public due to, among other reasons, differences in values and beliefs that affect the perceived credibility of the information received (see e.g. Kahan et al., 2010). Relating to the second causal link, while it might be true that people typically underestimate the effect of Pigouvian taxes on the taxed activity, it is first of all not certain that they would be very impressed by knowing the true effectiveness (fuel tax elasticities are typically -0.1 to -0.3), and second, it is not certain they would trust this information. It seems, however, that experience with taxes – as opposed to publicly provided information – can be effective in changing the public view of Pigouvian taxes (Winslott-Hiselius et al., 2009; Cherry et al., in press). Finally, it seems likely that support for fuel taxes could be increased by alleviating concerns about negative distributional impacts. This could potentially be done though transfers to low income households (as done in the case of the carbon tax in British Columbia), or by having regionally differentiated which are higher in cities. This is because support is higher if driving is not perceived as a necessity, and there are fewer alternative means of transportation in rural than in areas.

[6] This result depends on a narrow interpretation of what constitutes self-interest. There could be self-interested motivations for caring about both environmental conseqences and consequences to others.

In our survey the standard economic model of self-interested behaviour is not well-suited for explaining voting intentions. It is instead *Beliefs about environmental consequences* (primarily those related to climate change) that provides the most explanatory power. Beliefs about consequences to others, and socio-political variables also have greater explanatory power than beliefs about consequences to self. Our results thus indicate that there is much to gain from taking a broader approach to explaining attitudes towards environmental taxes by accounting for a wide range of motivational factors.

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7 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.

Q: 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?

Alternatives: Remove the taxes (i.e. reduce the tax by around NOK 5 per litre); Reduce the taxes by NOK 1 per litre; No change to the tax rate; Increase the taxes by NOK 1 per litre; Double the fuel taxes (i.e. increase the taxes by around NOK 5 per litre).

Q: To what extent do you agree with the following statements:

- Increased fuel taxes will result in less [car] driving and lower emissions in Norway
- 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.

Q: 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.

Q: 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.

Q: What is the highest level of education you have completed?

Alternatives: Secondary school; High school [sixth form college]; University or college up to four years; University or college more than four years.

Q: 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.

Q: 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.

Q: 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.

Q: 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.

Q: Does your household have daily access to a car?

Alternatives: Yes; No.

Q10 [Conditional on the previous question] In total, how many kilometres 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 kilometres your cars are insured to drive per year)?

Alternatives: open ended.

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

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

In addition to the questions asked in this questionnaire, we have information from the Synovate web panel about 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.