The Impact of Trial Runs on the Acceptability of Pigouvian Taxes: Experimental Evidence

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Sammendrag: Artikkelen tar utgangspunkt i de politiske utfordringene knyttet til å innføre effektive Pigouvianske avgifter (miljøavgifter). Ved å bruke en avstemning i et markedseksperiment med eksterne kostnader undersøker vi effekten av prøveperioder (erfaring med avgiften) på aksepten for to teoretisk sett ekvivalente avgifter. Selv om det er i deltakernes økonomiske egeninteresse å innføre begge avgiftene, observerer vi signifikant motstand mot begge, selv om graden av motstand varierer betydelig. Resultatene viser at prøveperioder kan bidra til å redusere skatteaversjon, og øker aksepten signifikant. Denne effekten er robust på tvers av de ulike avgiftene, men erfaring med en type avgift påvirker ikke aksepten for en annen type avgift. Prøveperioder reduserer også den bias som opprinnelig finnes i preferansen for de to (ekvivalente) avgiftene.

Abstract: This paper examines the political difficulty of enacting welfare-enhancing Pigouvian taxes. Using referenda in a market experiment with externalities, we investigate the effect of trial periods on the acceptability of two theoretically equivalent variants of Pigouvian taxes. While implementing either tax is in subjects' material self-interest, we find significant levels of opposition to both tax schemes, though the level differs considerably. Results show that trial runs can overcome initial tax aversion, significantly increasing acceptability. The effect is robust across tax schemes, but a trial with one scheme does not affect the acceptability of the other. Trial periods also mitigate initial biases in preferences of alternative tax schemes.

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Acknowledgements

1   Introduction

A significant challenge facing effective environmental policy is the political difficulty of implementing a Pigouvian tax—a tax intended to increase social welfare by incentivizing agents to internalize the external costs of an externality. Recent history is littered with failed attempts to enact a Pigouvian tax (or something similar), including the rejection of a Btu tax in the U.S. (Erlandson, 1994), the failure of the 2005 referendum to impose an Edinburgh road user charge (Gaunt et al., 2007), the rejection of the 1993 proposal to increase the value added tax on domestic energy in the U.K. (Dresner et al., 2006a), and the rejection of three proposals in 2000 to tax fossil energy in Switzerland (Thalmann, 2004).

This challenge, of course, is not new. Starting with Buchanan and Tullock (1975), the large literature on rent-seeking behaviour and special interest groups provides numerous arguments that can explain why proposals for welfare-enhancing Pigouvian taxes are defeated in the political process, and why the design is often suboptimal when such taxes are enacted.[1] Most of this literature is focused on the role that businesses and NGOs play in policy formulation. These are, however, not the only actors that can influence policy. The public's opinion also matters. This is obvious in some cases, such as when a tax proposal must receive a majority of the votes in a public referendum to be implemented, but in many other cases, the link between public acceptability and political feasibility is less direct. While policy can be advanced in the absence of strong support, elected policymakers often cannot politically afford to enact highly unpopular policies (List and Sturm, 2006). Indeed, in the case of the proposed Btu tax in the U.S., public officials rejected the policy in response to strong public opposition (Erlandson, 1994). And as Gaunt et al. (2007) point out, "commentators now acknowledge that the greatest impediment to implementation [of the Edinburgh road user charge] is public … acceptability."

Given that public opposition to Pigouvian taxes is a major barrier to enacting welfare-enhancing policies, what can be done to overcome this opposition? The successful implementation of a congestion charge in Stockholm may provide some insights to this question. Prior to a public referendum on the congestion charge, there was a trial run that enabled people to experience the workings and impacts of the policy. The experience seemed to boost acceptability, increasing public support in the polls by 18 percentage points. The increase in support was sufficient for the tax to win a majority in the public referendum, a win not predicted in the polls before the trial began (Winslott-Hiselius et al., 2009; Schuitema et al., 2010). Considering the concurrent political and procedural influences, such as lobbying activities, voting rules, and public relations, the impact of the trial run remains an open question.[2] Indeed, Hong Kong conducted a two-year pilot of an electronic road pricing system, after which local government boards voted down permanent implementation because of continued public opposition (Hau, 1990).

The prospect of trial runs raises two questions. First, when individuals form opinions about environmental taxes, can opposition arise from cognitive constraints and illusions instead of material self-interest, and second, can such behavioural influences be mitigated if people experience a trial period of the workings and impacts of the policy instrument. Considering

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[1] See for instance the Journal of Public Policy special issue on interest group influence (Dür and De Bièvre, 2007).

[2] A key procedural element was the decision to only allow Stockholm residents a vote in the referendum, which excluded affected commuters that lived in surrounding areas. Feeling disinfranchised, many surrounding areas held their own non-binding referendum to express their preferences, which were generally in opposition to the congestion charge.

the role of public perceptions in determining the acceptability of environmental taxes, it is important to investigate mechanisms, such as trials, that overcome opposition to welfare-enhancing policies. Herein, we formally examine whether a trial run with a Pigouvian tax can lessen behavioural aversions and opposition to the welfare enhancing policy. Our results indicate that it can, thereby increasing the acceptability of the tax. The finding is robust across different Pigouvian tax schemes.

2   Background

Previous work provides some background on the behavioural elements that impede acceptability and obstruct the implementation of efficient taxes. Perceptions of taxes play a central role in determining acceptability. Many studies have explored fiscal illusion, which contends that the institutional manner in which citizens must pay for government affects taxpayer perceptions of the price of government (Wagner, 1976; Heyndels and Smolders, 1995; Rosen, 1976). Sausgruber and Tyran (2005) find that people underestimate the tax burden of an indirect tax, whereas this is not the case for a direct tax, and that this illusion distorts the decisions in a (laboratory) referendum and leads to excessive redistribution. Similarly, acceptability is negatively impacted when people are uncertain about the effectiveness and purpose of the Pigouvian tax. People have a hard time understanding how a tax can increase welfare, and they also tend to doubt that taxes are effective in influencing behaviour (see Kallbekken et al., forthcoming). For instance, Dresner et al. (2006b) report that both the general public and business view "taxes solely as a means of raising revenue, rather than in terms of their incentive effects." And, in case of the failure of the Edinburgh road user charge, Gaunt et al. (2007) note "the public was largely unconvinced that the scheme would have achieved its dual objectives of reducing congestion and improving public transport."[3]

As the workings of Pigouvian taxes are not well understood, it seems many people perceive them simply as fiscal taxes. The term "environmental tax" therefore may seem justified to the public only if the revenues are earmarked for environmental measures. Indeed, an environmental earmark provides assurance that an environmental tax will directly improve environmental quality, which may explain, to some extent, the well-documented preference for earmarking (Bös, 2000; Brett and Keen 2000; Kallbekken and Sælen, 2011; Schuitema and Steg, 2008; Steg et al., 2006).

The Stockholm experience suggests that a trial run might refine perceptions and mitigate biases, and the literature provides some evidence to support this conjecture. A number of field and laboratory experiments have reported that individual decisions improved with different forms of experience, such as receiving within-treatment feedback of decisions over repeated trials—market experience and learning (e.g., Cherry et al., 2003; Sausgruber and Tyran, 2005) and using subjects with prior field or laboratory experience related to the decision— professional traders and experienced subjects (e.g., List, 2003; Hussam et al., 2008). The evidence, however, is not conclusive (e.g., Kluger and Wyatt, 2004; Haigh and List, 2005; Chen et al., 2007).

A trial run, in our setting, is unique because it offers a one-shot experience with the workings of a Pigouvian tax before binding referenda. The referenda then offer choices involving no tax

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[3] Perceptions about the distributional fairness of a tax can also influence attitudes towards a proposed environmental tax (Dresner et al., 2006b; Eriksson et al., 2006). Kallbekken et al. (2010) provides experimental evidence that distributional concerns significantly affected voting decisions over alternative tax proposals.

and two alternative, but theoretically equivalent, Pigouvian taxes—a full and threshold tax. In contrast to the typical full tax, the Pigouvian threshold tax yields an efficient outcome while separating the incentive and income effects, which provides the incentives to reduce the externality to the optimal level while also providing less reason for political opposition (Pezzey, 2003; 2006). If subjects care about how tax revenues are being spent, then the threshold tax takes one layer of complication away. Therefore, the framework enables an investigation of the preferences of alternative Pigouvian instruments, and the potential for a trial to shift preferences in the direction of greater acceptability for the instruments.

3 Experimental Design and Hypotheses

3.1 Experimental Design

3.1.1 The Market

To investigate the potential influence of a trial period on tax acceptability, we construct an experimental market with externalities, which can be internalized with an efficient Pigouvian tax. The market is structured as a uniform-price, multi-unit auction, which is predicted to converge quickly towards the equilibrium (see Smith et al., 1982, or Tyran and Sausgruber, 2005). The market consists of five buyers and one (automated) seller exchanging a fictitious good. The buyers impose external costs on each other through their purchases. In each period, each buyer can buy a maximum of six units. The buyers are informed about their resale values (which are 76, 50, 36, 24, 20 and 6 tokens for the six units, respectively), and also that the seller's marginal cost is between 8 and 14 tokens – and that it will remain constant throughout the experiment. The resale values are not common knowledge. The seller's actual marginal cost is 10 tokens per unit, and therefore the equilibrium unit price in the market is also 10 tokens.

At the beginning of each market period, the buyers indicate their willingness-to-pay (WTP), which is the WTP for each unit (instead of being asked for a unique WTP for each of the six units). The seller then sets the uniform price equal to the lowest WTP above the seller's marginal cost. All buyers with a WTP above the uniform price can then purchase as many units of the good as they wish (maximum of six), while all buyers with a WTP below the market price (and therefore below marginal costs) are excluded from making any purchases in this period.[4]

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[4] This set-up is a slight change from the regular uniform-price, multi-unit auction in that a buyer is not asked about his or her WTP for each unit. The consequence is that buyers (particularly during the early periods of the experiment) might not purchase a single unit even though they had a WTP for higher valued units above the marginal cost. This difference, however, becomes unimportant once the market approaches equilibrium, while the design facilitates easier subject understanding of the mechanism.
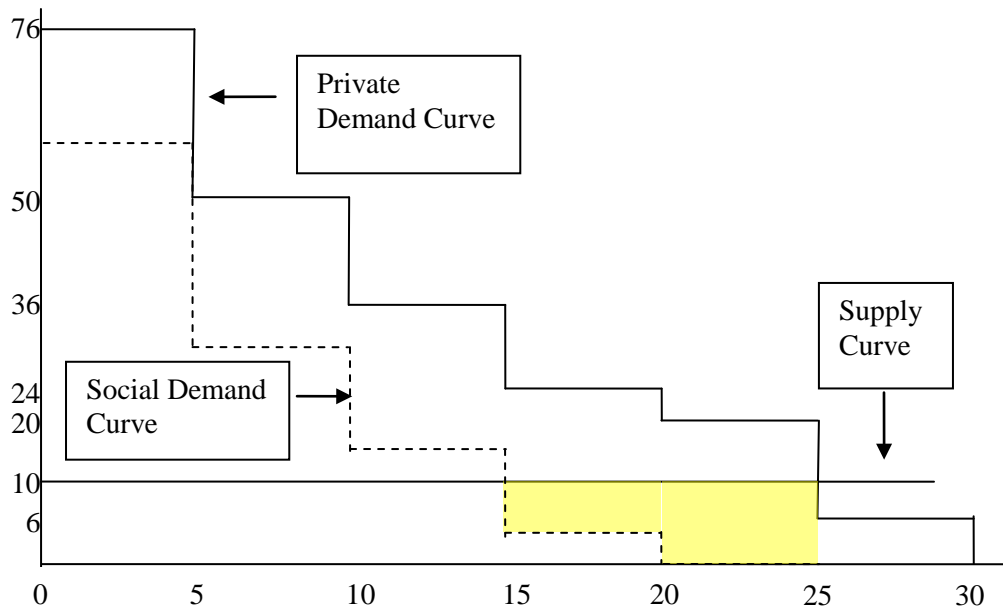
Figure 1. **Supply, demand and efficiency gains**

There are five buyers in each group. Whenever they purchase a unit of the good, they impose external costs of 5 tokens on each of the four other buyers in their group. The marginal damage from each unit purchased is therefore 20 tokens. The market equilibrium, without any tax, has all buyers purchasing five units at a price of 10. The socially optimal outcome, if the market price is below 20, is for each buyer to purchase three units. The socially optimal outcome, which can be achieved with an efficient Pigouvian tax, represents an improvement of 80 tokens over the market equilibrium, which translates to a 29 percent efficiency gain.[5] The shaded area in Figure 1 represents the efficiency improvement of the social optimum over the market equilibrium.

3.1.2   The Tax Schemes
We consider two Pigouvian tax schemes: the typical *full tax* and the less common *threshold tax*. Both the full and threshold taxes are efficient with a tax rate equal to the external cost of 20 tokens per unit. The new equilibrium would still yield a market price of 10 as can be seen in Figure 1. The equilibrium quantity, however, declines from 25 to 15 units, with individual buyers reducing the number of units purchased from 5 to 3 units. With either tax, the market equilibrium is shifted to equal the socially optimal outcome.

The difference between the full tax and the threshold tax is that the full tax imposes the tax on all purchased units whereas the threshold tax levies the tax only on purchases beyond the first 3 units (the socially optimal level). At equilibrium the two tax schemes produce identical outcomes.[6] Total individual profits under the full and threshold tax are 72 and 132 tokens,

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[5] Purchasing ten fewer units reduces external costs by 20 tokens per purchase for a total of 200, but that gain is partly counteracted by a loss in consumer surplus of 120 tokens (5*(10+14)).

[6] The two tax schemes are not identical from one specific ex-ante perspective: If participants believe resale values to differ between participants, and believe that some other participants have resale values for the 1st, 2nd or 3rd unit between the market price and the market price plus the tax, the threshold tax will be less efficient than the full tax..

respectively, but whereas the threshold tax generates no revenues, the full tax generates 300 tokens of revenue that are redistributed in equal shares to the buyers. Net payoffs, including external costs of 60 tokens that each subject suffers in equilibrium, are therefore equal across the full and threshold tax schemes, at 72 tokens, which is 16 tokens greater than the no-tax market equilibrium. Therefore, presuming material self-interest, people should prefer a tax over no tax because a tax, full or threshold, yields higher payoffs; and they should be indifferent between a full and threshold tax.

3.1.3 Experimental Framework

The experiment consists of two stages and follows a 2 x 2 design that varies two treatment variables: trial run (trial and no-trial) and tax scheme (full and threshold). We first review stage one (see table 1). In the no-trial treatments, subjects participate in ten market periods without any tax. In the trial treatments, subjects participate in an additional five market periods that impose one of two efficient tax schemes. The tax treatment, full or threshold, determines which tax is exogenously imposed in stage one of the trial treatments.

In stage two, subjects vote in three referenda that determine the tax policy for the subsequent three market periods. The full and threshold tax treatments, in addition to determining the tax in stage one (full tax-trial or threshold tax-trial), dictate the first and second referendum in stage two. In the full (threshold) tax treatment, the first referendum is between a full (threshold) tax and no tax and the second referendum is between a threshold (full) tax and no tax. The third referendum is the same in all treatments and presents a choice between the two tax schemes (full vs. threshold).

Table 1. **Timeline for the experiment.**

	Stage 1: No votes			Stage 2: Votes plus 3 periods after each vote		
	Periods 1-5	Periods 6-10	Periods 11-15	Vote 1	Vote 2	Vote 3
Full + Trial	No tax	Full Tax	No tax	Full vs. No tax	Thres vs. No tax	Full vs. Thres
Full + No Trial	No tax	No tax	--	Full vs. No tax	Thres vs. No tax	Full vs. Thres
Threshold + Trial	No tax	Thres Tax	No tax	Thres vs. No tax	Full vs. No tax	Full vs. Thres
Threshold + No Trial	No tax	No tax	--	Thres vs. No tax	Full vs. No tax	Full vs. Thres

The design provides four treatments: *full tax with no trial, full tax with trial, threshold tax with no trial*, and *threshold tax with trial*. We are interested in how the trial treatments in stage one affect voting behaviour over the alternative tax schemes presented in stage two. The experimental design facilitates a clean investigation of questions regarding the ability of a trial run to overcome individual resistance to a tax policy that is materially beneficial. As Falk and Heckman (2009) point out, experimental methods are well-suited for such inquiries of individual decision-making because the lab offers control over key elements that are often fixed or unobservable in the field. In our case, the lab offers clarity by varying tax schemes while maintaining control over alternative payoffs and induced values—e.g., the incentive structure's impact on payoffs is unambiguous, the use of tax revenues is unambiguous, and the decision-makers and the decision process is unambiguous.

3.1.4   Procedures

The experiment was conducted in the summer of 2009 at the University of Copenhagen with a total of 170 student participants. We ran nine sessions with two or three sessions per treatment and two to five independent markets per session, which resulted in 34 independent markets for the entire experiment. Due to "no-shows" we had an uneven number of subjects across the four treatments: 40 subjects (8 markets) in *full tax with no trial*; 45 subjects (9 markets) in *full tax with trial*; 50 subjects (10 markets) in *threshold tax with no trial*; and 35 subjects (7 markets) in *threshold tax with trial*. Students who had previously participated in similar experiments were not invited to participate. The students were required to answer questions (and were later provided with the correct answers) to make sure they understood the market before the experiment began. Each session lasted about 105 minutes, including reading the instructions and the questionnaire at the end of the session. Subjects earned an average of DKK 207 (about US$42). The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007).

3.2   Hypotheses

Presuming rational material self-interest, subjects should cast a vote in favour of either efficient tax (full or threshold) over a no-tax alternative. However, evidence from voting behaviour indicates this may not be the case—people sometimes vote against a tax even if it is in their material self-interest to vote in favour of it (Sausgruber and Tyran, 2005; Kallbekken et al., 2010 and forthcoming). This is what we define as *tax aversion* for the purpose of this paper: to vote against a tax scheme that would increase both own and group payoff. There are no theoretical models which can fully explain tax aversion, but it is nonetheless an empirical phenomenon. By using identical payoff functions for all participants, we avoid the potential for distributional concerns to confound our results (see Kallbekken et al., 2010).

The research question is whether a trial run with an efficient Pigouvian tax can mitigate people's tax aversion, which gives the first null hypothesis: $\mathbf{H_O}^1$: a trial with a full (threshold) tax has no significant effect on its acceptability.

Incorporating two alternative efficient tax schemes enables us to explore the extent and robustness of any effect from a trial by testing whether a trial with one efficient tax influences acceptability of a different efficient tax. Specifically, does a trial run with a full (threshold) tax affect the acceptability of a threshold (full) tax? This provides the second null hypothesis: $\mathbf{H_O}^2$: a trial with one efficient tax does not affect the acceptability of another efficient tax.

Another layer of inquiry is possible due to the referendum between the full and threshold tax. On material grounds, subjects should be indifferent between the full and threshold tax. The threshold tax is, however, likely to be more acceptable because the scheme separates the incentive and income effects; providing the same incentives at the margin, while transferring less money from the polluter to the government (Pezzey, 2003). We suspect that any effect from a trial run should translate to an increase in the relative preference for the full tax. Specifically, does a trial with an efficient tax (full or threshold) mitigate any bias for the full tax; thereby increasing the acceptability of the full tax relative to the threshold tax? Correspondingly, we present the third null hypothesis: $\mathbf{H_O}^3$: a trial with an efficient tax does not affect the relative support of full and threshold taxes.

4 Results

As the potential for Pigouvian taxes to enhance efficiency is the key motivation for our research questions, it is natural to review the actual efficiency achieved in our treatments before we proceed to analyzing voting behaviour. Table 2 reports the mean payoffs, market prices and units purchased by treatment in stages 1 and 2. First, a review of the separate instances of the no-tax setting reveals that the market outcomes improved in each subsequent instance - average payoffs increased and both market prices and the number of units purchased approached equilibrium predictions. Next, consistent with theory, average payoffs are consistently higher with either tax than without a tax. The absolute difference in average payoffs between no tax and either tax scheme is somewhat smaller than the predicted difference (11-15 vs. 16 tokens).[7]

The average price is consistently around 11. This does not affect incentives (in terms of which scheme to vote for or how many units to purchase), but it does reduce payoffs compared to theoretical equilibrium payoffs. While the incentives are identical across the schemes, payoffs are slightly higher with the threshold tax than with the full tax in both stage 1 and 2. This outcome arises because subjects purchase the social optimum of three units more frequently under the threshold tax scheme (75% and 82% of the time) than under the full tax scheme (65% and 67% of the time), which may be due to the threshold, which is set equal to the social optimum, acting as a focal point.

Table 3 shows aggregate voting behaviour by vote and treatment. The table reports the percentages of votes in favour of the tax in referenda 1 and 2, when the choice was between a tax (full or threshold) and no tax.

Table 2. **Mean profit, price and number of units bought per period by stage and implemented scheme**

	Stage 1				Stage 2		
	No tax		Trials				
	First 5	Last 5*	Full	Threshold	No tax	Full	Threshold
Mean Profit	43.83	50.52	61.60	63.28	51.13	64.91	66.24
Mean Price	11.84	10.92	11.18	10.97	10.64	10.79	10.69
Mean Quantity	4.51	4.66	2.97	3.17	4.77	3.06	3.07

Note. * The last 5 periods are periods 6-10 for the no-trial treatments and periods 11-15 for the trial treatments.

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[7] Calculated within each stage, and excluding the first five periods.

Table 3. **Votes in favour of the tax when the alternative is no tax (votes 1 and 2)**

Treatment/Vote	No Trial	Trial
Full tax treatments: Votes for full tax (Vote 1)	40% (16/40)	58% (26/45)
Full tax treatments: Votes for Threshold tax (Vote 2)	60% (24/40)	78% (35/45)
Threshold tax treatments: Votes for Threshold tax (Vote 1)	42% (21/50)	69% (24/35)
Threshold tax treatments: Votes for full tax (Vote 2)	50% (25/50)	51% (18/35)

The numbers indicate significant levels of tax aversion—opposition to a tax when it is materially beneficial—but the numbers also indicate that a trial run diminishes this aversion. From the first row, 58 percent of subjects voted in favour of the full tax after a trial with the full tax, as compared to 40 percent when they had no trial (p=0.104).[8] This result is more pronounced for the threshold tax. From the third row, the difference in the percentage of votes in favour of a threshold tax between those with and without a trial with a threshold tax is 42 and 69 percent (p=0.015). Aggregate numbers therefore provide some initial support for rejecting the first null hypothesis, suggesting that a trial run with a tax scheme increases its acceptability.

We consider the reach of a trial by testing whether a full tax trial influences the acceptability of a threshold tax, and vice versa. Results from Table 3 provide mixed results. Support for a threshold tax is significantly greater when voters had a full tax trial relative to when they had no trial with either tax (78 vs. 60 percent; p=0.077), but support for a full tax was not significantly influenced by having a threshold tax trial (51 vs. 50 percent; p=0.898). Unconditional results are therefore mixed regarding the second null hypothesis.

To further explore the influence of trials, we examine whether a trial run with a tax causes an increase in the support for the full tax relative to the threshold tax, presuming an initial bias towards the threshold tax. The aggregate numbers do indicate a strong preference for the threshold tax despite the fact that the full and threshold tax are materially equivalent at equilibrium, and further, the numbers suggest that a trial increases the relative support for the full tax. Specifically, as Table 4 reports, 24 percent of voters across all treatments supported the full tax over the threshold tax, but stratifying by trial and no-trial reveals that support for the full tax was significantly greater when subjects had a trial run with a full or threshold tax (31 vs. 18 percent; p=0.041). Unconditional numbers appear to reject the third null hypothesis, implying that trials mitigate initial biases for the full tax and increase relative support for the full tax.

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[8] Tests of means were conducted using a t-test allowing for unequal variances. Coincidentally, 18 percentage points is also the increase in support for the Stockholm congestion fee from before to after the trial period (Winslott-Hiselius et al., 2009).

Table 4. **Voting outcomes in the full vs. threshold referendum (vote 3)**

Treatment	Votes for Full Tax	Votes for Threshold Tax
Full tax + No Trial	22% (9/40)	78% (31/40)
Full tax + Trial	31% (14/45)	69% (31/45)
Threshold tax + No Trial	14% (7/50)	86% (43/50)
Threshold tax + Trial	31% (11/35)	69% (24/35)
Overall	24% (41/170)	76% (129/170)

We now turn to a conditional analysis of individual voting behaviour to further develop our initial impressions. To examine the probability of voting in favour of a proposed tax, we estimate the following linear probability model:

$$Y_{it} = \alpha + \psi Trial_i + \delta TaxVote_{it} + \gamma Trial_i * TaxVote_{it} + \phi_t + u_i + \varepsilon_{it},$$

where Y_{it} is a limited dependent variable that indicates whether the ith subject voted in favour of the proposed tax in period t (=1 if yes; =0 otherwise); $Trial_i$ is a vector of indicator variables that signifies the trial setting of the ith subject - no trial (omitted baseline), full tax trial, and threshold tax trial (=1 if yes; =0 otherwise); $TaxVote_{it}$ is a binary variable that indicates the referendum for subject i in period t was a choice between a threshold tax and a full tax; $Trial_i * TaxVote_{it}$ is a vector of interaction terms that capture the vote-specific effect of the trial runs; ϕ_t is a set of T-1 dummy variables that capture potential nonlinear period effects; α is the estimated intercept, u_i are random effects that control for unobservable individual characteristics (e.g., risk aversion), and ε_{it} is the well-behaved error term.[9] To ensure any treatment effect of the trails is not confounded with the potential influence of prior experience with tax schemes that were implemented via referenda, the model includes an control variable that signifies whether the subject had experience with a tax from a previous referendum and an interaction of this variable with the threshold versus full referendum to allow a vote-specific effect.[10]

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[9] The between-treatment design requires that individual effects are conditioned using a random effects specification, which LM tests confirm are significant (p=0.003). Period-specific effects are jointly significant (p=0.059).

[10] Note the *potential* for influence only exists a third of votes; the second and third referenda, not the first.

Two basic models are estimated, a full-tax model and a threshold-tax model. For each, we supplement the linear model with a non-linear logit specification.[11] In the full-tax model, the proposed tax is the full tax and the model estimates the decision to vote in favour of the full tax as a function of the treatments (no trial, full tax-trial, and threshold-tax trial), the alternative to the full tax (no tax or threshold tax), and interaction terms that disentangles any referendum-specific treatment effects for the full versus threshold vote. The threshold-tax model works equivalently. The proposed tax is the threshold tax and estimates condition the decision to vote in favour of the threshold tax on the treatments, the alternative and an interaction to capture any differential treatment effects across referenda type. To estimate the models, we first stratify the data by vote type: (a) full-tax versus no-tax, (b) threshold-tax versus no-tax and (c) threshold-tax versus full-tax. Estimation of the full tax model only uses data from referenda that present the full tax as an option; (a) and (c). Likewise for the threshold tax model—(b) and (c). Note the data from the full-tax vs. threshold-tax referendum (type c) is present in both models, but the vote is coded to reflect the model's orientation.[12]

Table 5 reports the estimated coefficients from the linear probability models and the marginal effects from the logit models. The conditional estimates reject the first null hypothesis and corroborate the aggregate findings that a trial run with an efficient tax can improve the acceptability of that tax. From the full-tax model, results suggest that a trial with a full tax significantly increases the likelihood of voting in favour of the full tax; increasing it by 18.8 percentage points (p=0.06). The result is stronger in the threshold model with estimates indicating that a trial with a threshold tax significantly increases the likelihood of voting in favour of the threshold tax by 26.6 percentage points (p<0.01). However, it appears the influence of trial runs is not without limits. Estimates show that a trial with a threshold tax has no significant effect on the likelihood of supporting a full tax (p=0.42) and a trail with a full tax does not influence the support of a threshold tax (p=0.21). Therefore, trial runs of an efficient tax may mitigate tax aversion and bolster support for that same tax scheme, but this effect does not appear to extend to different efficient tax schemes. This implies that trial runs improve the understanding of a specific Pigouvian tax scheme rather than a general understanding of Pigouvian taxes.

Turning to the third hypothesis, we examine the impact of a trial run on the relative preference of the two efficient tax schemes. We first point out that the estimated coefficients for the threshold vs. full variable in each model reveal a strong preference for the threshold tax. The likelihood of supporting a full tax decreases about 21.5 percentage points when the alternative is a threshold tax instead of no tax, and the likelihood of supporting the threshold tax increases by about 44.9 percentage points when the alternative is a full tax as opposed to no tax. Considering that subjects should be generally indifferent between the full and threshold taxes, we extend the investigation of trial runs by testing whether trials can shift the strong preference for the threshold tax closer to indifference. Estimates provide some support for this conjecture. In the threshold tax models, estimated coefficients on the interaction terms reveal that a trial run with a full or threshold tax shifts considerable support from a threshold tax to a full tax (p<0.01); thereby rejecting the third null hypothesis. Results from the full tax model offer corresponding evidence that trial runs with a threshold tax, but not full tax, influence relative preferences of the two tax schemes (p=0.06).

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[11] The linear probability model appears suitable for our data, but to confirm, we also report results from the non-linear logit specification.

[12] Support for proposed tax equals 1 (0 otherwise); therefore, a vote for a full tax in the full vs. threshold referenda is coded as 1 in the full-tax model and codes as 0 in the threshold-tax model.

Table 5. **Panel Model Estimates of Voting Models**

	Full-Tax		Threshold-Tax	
	Linear (*coef*)	Logit (*dy/dx*)	Linear (*coef*)	Logit (*dy/dx*)
Constant	0.390*** (0.072)	--	0.420*** (0.063)	--
Trial w/ Full Tax	0.188* (0.100)	0.240* (0.142)	0.122 (0.098)	0.129 (0.092)
Trial w/ Threshold Tax	-0.095 (0.118)	-0.114 (0.132)	0.266*** (0.098)	0.196*** (0.069)
Threshold vs. Full Vote	-0.215** (0.100)	-0.319*** (0.135)	0.449*** (0.097)	0.430*** (0.096)
Trial w/ Full Tax & Threshold vs. Full Vote	-0.056 (0.123)	-0.028 (0.154)	-0.232* (0.130)	-0.295* (0.163)
Trial w/ Threshold Tax & Threshold vs. Full Vote	0.231* (0.137)	0.365* (0.196)	-0.395*** (0.132)	-0.423*** (0.140)
Tax in Previous Referenda	0.197* (0.117)	0.237* (0.148)	0.333*** (0.099)	0.338*** (0.101)
Tax in Previous Referenda & Threshold vs. Full	-0.192 (0.140)	-0.193 (0.136)	-0.404*** (0.132)	-0.445*** (0.143)
χ^2 (p-value)	42.94 (0.000)	26.47 (0.000)	41.88 (0.000)	34.59 (0.000)
N	340	340	340	340

Note. Dependent variables are a binary variable equal to 1 for a yes vote and 0 for a no vote; estimates control for individual-specific and period-specific effects; standard errors are reported in parentheses unless otherwise noted; and *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

5 Discussions

Our results reveal three main findings. First, as observed in the case of the congestion charge in Stockholm, a trial run with an efficient tax can significantly increase the acceptability of the tax. This result arises whether the tax is a full tax or a threshold tax. Second, the influence of a trial appears limited because a trial period with one efficient tax does not influence the acceptability of another efficient tax. Third, the threshold tax was overwhelmingly preferred to the full tax despite being materially equivalent, but a trial with an efficient tax seemed to mitigate the bias, increasing the relative support of the full tax.

The positive result of a trial run indicates that tax aversion is related to a bias or misperception that can be overcome. In this experiment the opposition to a Pigouvian tax is overcome with a trial period, whereas providing information alone did not increase support for efficient taxes in a previous experiment (Kallbekken et al., forthcoming, used a cheap-talk design to test the effect of information and of labeling). Of course, in the world outside the lab there are other factors that will interact with this result, such as the immediacy of the behavioural effects from the policy, availability and cost of alternatives, and the ease of changing behaviour. However, people often find it easier than expected to change behaviour and find this new behaviour more favourable than expected, as illustrated by experiences with the "most popular tax in Europe," the Irish plastic bags levy (Convery et al., 2007), and the Stockholm experience itself (Schuitema et al., 2010).

Additional research could provide further insights on the potential of trials to mitigate tax aversion. If tax aversion is mitigated because people initially underestimate the environmental benefits of the tax, and a trial run corrects this misperception, then the possibility of using trials as a means to boost support might be limited to cases where the tax will produce immediate and observable benefits for the involved parties (like congestion, but unlike climate change). If, however, tax aversion is mitigated because people, for instance, find it easier than expected to change behaviour, then the use of a trial period as a policy tool has wider applicability. As Schuitema et al. (2010) point out in the final sentence of their paper, "making sure that people have the opportunity to gain positive expectations, and when possible, positive experiences with road pricing is one important factor for securing public support."

Another potential caveat is that people might not trust that a trial is merely a trial (Milton Friedman argued that nothing is so permanent as a temporary government programme). If people fear that the trial will be made permanent independently of the results and subsequent deliberations, a trial might face as strong opposition as a permanent implementation of the tax. This potential problem can be overcome with credible assurances that the trial is temporary (e.g., if implementation requires achieving a majority in a referendum).

The preference for the threshold tax over the standard (full) Pigouvian tax indicates that the revenues are crucial for support (as revenue collected is the only difference between the two taxes). This implies that distrust/risk aversion/loss aversion is possibly part of the reason for lack of support for (full) Pigouvian taxes. The popular but less common (and less researched) threshold tax may provide an interesting and politically relevant alternative to the more conventional full tax.[13] Under certain assumptions (see Pezzey 2003, 2006), a threshold tax provides the same outcome as a standard tax except for the smaller revenues it raises. Threshold taxes have not been widely considered, but they are a compelling alternative because the tax separates, in part, the incentive and income effects; therefore providing a

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[13] While Pigouvian threshold taxes are uncommon, income taxes quite often have thresholds (for distributional reasons).

framework that reduces the externality to the optimal level while also providing less reason for political opposition.

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