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Pigouvian tax aversion and inequity aversion in the lab

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Abstract

We use an experimental market with externalities to test whether inequality aversion could help explain the popularity of earmarking tax revenues. We find that voter opposition is not fully explained by material self-interest: Results indicate that preferences for fairness influence voting behavior, with greater inequality in tax revenue distribution negatively affecting the acceptability of the tax. In addition to this, we also discover a significant degree of tax-aversion in the votes. Our findings provide greater understanding of the behavioral underpinnings of the positive impact that earmarking has on the acceptability of Pigouvian taxes.

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1. Introduction

Despite successes with incentive-based policies, such as the congestion charges in London and Stockholm, they still face considerable skepticism from the public. In particular, proposals for new gasoline taxes are met with strong opposition. This sentiment limits the ability of policymakers to implement a relatively simple instrument that can effectively address externalities. The literature, however, offers hope for Pigouvian taxes by indicating that earmarking tax revenues can increase the public acceptability of the tax (Schuitema and Steg, 2008; Hsu et al., 2008; Thalmann, 2004). Earmarking, by mitigating public opposition, may relax the constraints and open the doors of more effective policy. The success of earmarking, however, depends on a better understanding of the behavioral underpinnings of earmarking and Pigouvian taxes.

Since Buchanan's (1963) seminar paper that explained earmarking in a consumer-decision framework, research efforts have identified issues such as preferences for specific over general spending programs (McCaffery and Baron, 2003; Baron and McCaffery, 2004), the need for a logical link between taxation and spending (Deroubaix and Lévèque, 2006; Kallbekken and Aasen, in press), and trust in government (Dresner et al., 2006; Goode, 1984). The issue of heterogeneity in externalities has largely been overlooked. The omission is relevant because the absence of heterogeneity inherently ignores distributional preferences, which have been shown to influence decisions in many settings (Fehr and Schmidt, 1999). Herein we address this issue by conducting a series of experiments that examine how preferences for fairness may explain, in part, the positive effect that earmarking tax revenues has on the acceptability of Pigouvian taxes.

That fairness matters for the acceptance of environmental policies, as it does for other policies, has been documented (see, for example, the overview article by Johansson-Stenman and Konow, 2010). However, while efficiency is often relatively easily defined, fairness is a more elusive concept. We use two metrics to investigate inequality aversion in the context of Pigouvian taxes. We look at how the distribution of tax revenues and the distribution of tax impacts affect the acceptability of Pigouvian taxes. The experimental method is particularly useful for our investigation because the lab offers control over the heterogeneity of externalities and the alternatives in the referenda, while also using induced values that mitigates some of the issues associated with secondary data.[1]

2. Experimental design

Our experiment consists of a market in which some buyers impose external costs on others through their purchases of a fictitious good. After trading periods without taxation, the buyers participate in six votes, in which they face binomial choices between different taxes on the polluting units with different rules for how to return the revenues. Votes serve as an indicator of an individual's acceptability of the alternative tax proposals. The allocation of revenues can be interpreted as a transfer to the members of specific groups. Though we model this as a lump-sum transfer, earmarking revenues in practice could take other forms, such as directing revenues from congestion charges for road improvements.

Each market consists of five (human) buyers and one (automated) seller. The seller's marginal cost is 20 tokens; the buyers have resale values of 140, 110, 80 and 50 tokens for the four units they wish to purchase. We employ a variation of a uniform-price multi-unit auction (Smith et al., 1982). In each market period, the buyers first indicate their willingness-to-pay (WTP) for one unit, and then the seller sets the uniform market price equal to the lowest WTP above the seller's marginal cost. All buyers with a WTP above the uniform price are asked

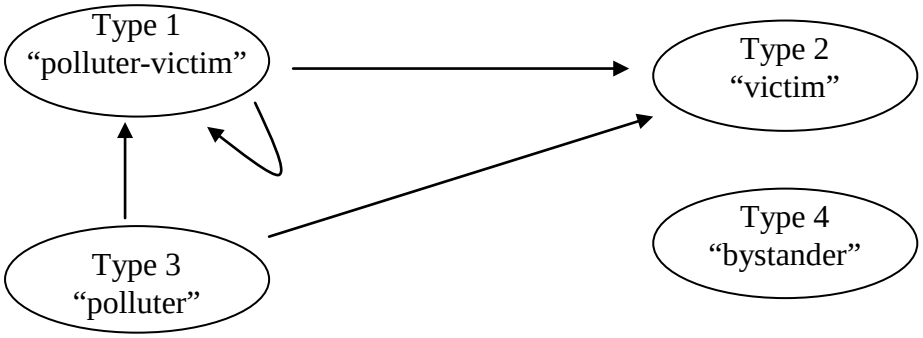
[1] Indeed, previous experimental work has provided new insights on the role of voting outcomes on tax compliance (Alm et al.,1999) and the differential impact of direct and indirect taxes on the likelihood of voting in favor of redistribution (Sausgruber and Tyran, 2005).

how many units of the good they want to buy, while all buyers with a WTP below the market price (and therefore below marginal costs) automatically purchase zero units in the period.

The five buyers can be either "polluters" or "non-polluters," and either "victims" or "non-victims." Therefore, heterogeneity exists along two dimensions. In each group, there are four different types of buyers. Figure 1 shows the four types and the direction of external costs.

Of the five buyers, two are "bystanders" (type 4), one is "polluter" (type 3), one is "victim" (type 2), and one is "polluter-victim" (type 1). Whenever type 1 and 3 buyers (polluter and polluter-victim) purchase one unit of the good, it results in an external cost of 20 tokens for each type 1 and 2 buyer (victim and polluter-victim).[2] In periods with taxation, the Pigouvian tax rate is set at 40 tokens (20 tokens damage for each of the two victims).

Figure 1: Direction of externalities



In the equilibrium without taxation, all buyers purchase four units each at a price of 20 tokens, but the socially optimal outcome calls for type 1 and 2 subjects to buy only three units. The socially optimal outcome can be achieved by introducing a per-unit tax with a rate equal to the marginal damage caused by each unit.

The subjects vote on four different tax regimes in six pair-wise votes. In the first ten periods, no tax is levied on any of the subjects, and a pure market game is played. There are votes on taxation in periods 11, 14, 17, 20, 23 and 26. The regimes differ with respect to how the revenue is allocated, as illustrated in Table 1.

Table 1: Tax regimes

Tax regime	**Description**
No tax (N)	No tax implemented
General (G)	Pigouvian tax implemented with revenues redistributed to all subjects in equal lump-sum payments.
Polluters (P)	Pigouvian tax implemented with revenues redistributed only to types 1 and 3 – the polluters.
Victims (V)	Pigouvian tax implemented with revenues redistributed only to types 1 and 2 – the victims from the pollution.

The general tax regime (G) is representative of a non-earmarked use of tax revenues—independent of who caused the pollution and who suffered from it; the revenues are returned

[2] Note that when a type 1 buyer purchases one unit it will not only reduce the gains of other participants of type 1 and 2, but also reduce her own gain by 20 tokens. Technically, a buyer inflicting a cost on herself would not cause an "external" cost, but for reasons of symmetry and parsimony we do not call the self-inflicted cost an internal cost for buyers of type 1. This distinction does not have an impact on the equilibrium predictions and the social optimum.

to the general public in the form of lump-sum payments. The polluter tax regime (P) redistributes tax revenues to polluters, which corresponds to a case of compensating the polluters to minimize the cost to (and opposition from) polluters. The victim tax regime (V) redistributes the tax revenues to victims, which follows the rationale that victims should be compensated for incurring the cost of pollution, even if the level is efficient. Under this regime, the victims receive two benefits from the tax: a reduction in pollution due to the tax and the receipt of earmarks from the tax.

Note that tax regimes *P* and *V* share the important property that the benefits accrue to specific groups along the same divisions as the externality problem itself (polluters and victims). This specification of earmarking revenues from a Pigouvian tax links the issue of earmarking more directly to the issue of public support.

Table 2 shows the predicted payoffs for the different subject types under the four different tax regimes (at the equilibrium price). These payoffs are based on consumer surplus, external costs suffered (types 1 and 2), taxes paid (types 1 and 3) and, depending on subject type and tax scheme, share of tax revenues. For example, consider the Polluters scheme: the subjects of types 1 and 3 buy three units and get a consumer surplus of 270 (= 120 + 90 + 60) and they pay a tax of 40 per unit, for a total tax payment of 120. But they both receive half of the tax revenues, 120 again. In addition, the subject of type 1 suffers external costs of 6x20 tokens, so she has a total payoff of 150 (=270-120+120-120), while the subject of type 3 receives a payoff of 270 (=270-120+120). Subjects of types 2 and 4 neither pay tax nor, under this tax scheme, receive tax revenues. But they materialize consumer surplus on a fourth unit, which is the reason why their payoffs are 30 tokens higher than those of the other types. The payoffs for the other tax schemes are calculated accordingly.

The table also displays the sum of payoffs across the five buyers and Gini indices for the distributions of overall payoffs and of tax revenue recycling.

Table 2: Payoffs by type, Gini coefficient for payoff distribution and for revenue allocation for each tax regime.

Tax regime	***Type 1***	***Type 2***	***Type 3***	***Type 4****	***Sum of all payoffs***	***Gini payoff***	***Gini revenue allocation***
No tax	140	140	300	300	1180	0.163	-
General	78	228	198	348	1200	0.230	0
Polluters	150	180	270	300	1200	0.148	0.6
Victim	150	300	150	300	1200	0.150	0.6

Note: *There are two subjects of type 4 in each group.

A few aspects of Table 2 are noteworthy. First, each tax regime increases overall efficiency, as measured by the sum of all payoffs, by only 1.7 percent relative to the no-tax baseline. This is motivated by the typical case in which an environmental policy has a relatively small, albeit measurable impact. Also, the benefits and costs of each tax system are unevenly distributed among the four types. The impact on Type 1 (polluter-victim) buyers depends on the tax regime, with lower payoffs under *General* and higher under *Polluter* and *Victim*. Type 2 (victim) buyers always gain from a tax, though to different degrees across tax regimes. Type 3 (polluter) buyers always lose, and Type 4 (bystander) buyers are only impacted by the distribution of tax revenues, not the pollution.

Second, the *General* tax regime seems to be the most egalitarian regime because the tax revenues are distributed as a lump-sum, independent of the type of buyer. Thus the Gini-coefficient for the distribution of tax revenues is 0. This impression of an egalitarian outcome

can be deceiving, however, since the final payoff distribution is not only impacted by the allocation of tax revenues, but also by who pays the tax, the level of externalities and the loss in consumer surplus. Under the *General* tax regime, final payoffs for Type 1 buyers are reduced relative to the no-tax baseline, which exacerbates the already low position they faced in the no-tax regime due to the externalities. Final payoffs of Type 4 buyers, one of the types with the highest payoffs in a market without tax, are increased under the *General* tax regime. Thus, while the *General* tax scheme has no variation in tax revenue distributions, it causes considerable variation in the final payoffs. Indeed, the *General* tax regime has the lowest Gini coefficient for tax revenue distribution among the four tax schemes and the highest Gini coefficient for payoff distribution. If subjects care about egalitarian motives, then the question arises whether they are more concerned about the distribution of tax revenues or the final distribution of payoffs.

The experiment was conducted at the University of Innsbruck (Austria) with 120 student participants (average age 23, 46% females, around 1/3 study economics and 1/3 study other social sciences). It was programmed and conducted with the software z-Tree (Fischbacher, 2007). There was a total of six sessions; each session included four independent markets with five subjects each and lasting about 80 minutes. Subjects earned on average €22 Euro (= $28 at the time of the experiment) including a show-up fee of €6.

3. Results

Voters faced six different votes—three between two alternative tax schemes and three between a tax scheme and no tax. Each vote entails different expected payoffs, payoff distribution and revenue distribution. Table 3 shows the support for each tax scheme in each of the votes by type. The numbers in parenthesis show the predicted outcome based on each type's material self-interest. A bar symbols that the two taxes yield the same outcome for the type in question, and that subjects should be indifferent from a material point of view. While subjects voted in line with their material self-interest to some extent, there are also some striking significant deviations from the predictions. For instance, support for taxation is 21 to 71 percentage points lower than predicted in columns 2-4 (where there is a *No tax* option), whereas in the four cases where support for *No tax* is predicted, fully 92% of votes do support *No tax* in three of the cases.

Table 3: Results of the votes and predicted votes shares by type

	------ Support for tax ------			Support for G		Support for V	N
Type	N v. G	N v. P	N v. V	P v. G	V v. G	P v. V	
1	8 % (0%)	29 % (100%)	33 % (100%)	17 % (0%)	21 % (0%)	58 % (-)	24
2	67 % (100%)	42 % (100%)	79 % (100%)	83 % (100%)	25 % (0%)	67 % (100%)	24
3	8 % (0%)	25 % (0%)	8 % (0%)	33 % (0%)	75 % (100%)	38 % (0%)	24
4	79 % (100%)	29 % (-)	35 % (-)	81 % (100%)	81 % (100%)	60 % (-)	48

To investigate whether inequity aversion may explain the popularity of earmarking of revenues, we estimate a set of linear probability models that defines voter support (a yes vote) as a function of the payoff distribution and revenue distribution. In each model, we control for a voter's expected payoff and any individual- and period-specific effects. In addition to this, models 1 and 2 control for inequity aversion, model 5 controls for tax aversion (voting against taxation when taxation is in the subject's material self-interest), while models 3 and 4 control

for both. As we do not know whether subjects are more concerned about the distribution of tax revenues (models 1 and 3) or the final distribution of payoffs (models 2 and 4) we explore both options. Table 4 reports the estimates.

Table 4: Panel estimates for voting models

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Constant	0.3743 (0.000)	0.3154 (0.000)	0.4222 (0.000)	0.4344 (0.000)	0.4712 (0.000)
Payoff	0.0031 (0.000)	0.0031 (0.000)	0.0031 (0.000)	0.0031 (0.000)	0.0031 (0.000)
Revenue distribution	-0.2123 (0.000)	--	-0.1225 (0.075)	--	--
Payoff distribution	--	1.7069 (0.000)	--	0.6041 (0.181)	--
No Tax	--	--	-0.0959 (0.131)	-0.1620 (0.000)	-0.1938 (0.000)
χ^2	194.12 (0.000)	174.90 (0.000)	196.71 (0.000)	194.87 (0.000)	193.01 (0.000)
χ^2 [var(u) = 0]	10.11 (0.002)	8.64 (0.003)	10.34 (0.001)	10.17 (0.001)	10.03 (0.002)
N	720	720	720	720	720

Notes: (1) Dependent variable is the individual subject's vote (yes=1; no=0).
(2) Estimates employ linear probability specification; results are robust across alternative specifications.
(3) Individual and period-specific effects are accounted for in the estimation; Hausman tests indicate a preference for a random effects specification.
(4) P-values are reported in parentheses.

Estimates from Model 1 indicate that inequity in tax revenue distribution negatively impacts voter support (p=0.000), while Model 2 reveals the unexpected result that inequity in payoff distribution positively impacts voter support (p=0.000). However, the latter result may be due to tax aversion because a review of the data reveals that voters tended to prefer the no-tax option over taxes that both yielded a more equitable payoff distribution and were in the voter's own material interest. To disentangle tax aversion from inequality aversion, we estimate voting models that controlled for the presence of a no-tax option (Models 3-5).

The results suggest that tax aversion is an issue. In models 4 and 5, the presence of a no-tax option has a significant negative effect on voter support (p<0.001). The estimated coefficient in Model 3 is also negative but fails to be significant at conventional levels (p=0.131)—likely an artifact of the correlation (0.81) between no tax and revenue distribution.

Revisiting our main hypothesis with controls for tax aversion, the estimates reveal that voter support remains negatively influenced by inequity in the tax revenue distribution, though with lower statistical and economic significance (p=0.075). We find that voter behavior is not significantly influenced by the payoff distribution (p=0.181), contrary to the unexpected positive effect when not controlling for tax aversion.

4. Discussion

Our results suggest that preferences for fairness influence voting behavior. Examining voting behavior over alternative earmarking schemes, we find that greater inequality in tax revenue distribution negatively affected the acceptability of the tax. Results reveal no evidence that tax acceptability is influenced by the inequality of outcomes from taxes. Voters therefore appear to express egalitarian motives when considering the distribution of tax revenues, not the distribution of final payoffs. While we find that voter opposition is not fully explained by material self-interest, this unexplained component cannot be fully characterized by preferences for fairness. We also discover a significant degree of tax-aversion. Our findings provide greater understanding of the behavioral underpinnings of the positive impact that earmarking has on the acceptability of Pigouvian taxes.

References

Alm, J., G.H. McClelland and W.D. Schulze (1999) "Changing the social norms of tax compliance by voting" *Kyklos* **52**, 141-171.

Baron, J. and E.J. McCaffery (2004) "Starving the Beast: The Psychology of Budget Deficits, Center for the Study of Law and Politics" University of Southern California working paper 37.

Buchanan, J.M. (1963) "The economics of earmarked taxes" *Journal of Political Economy* **71**, 457-469.

Deroubaix, J.F. and F. Lévèque (2006) "The rise and fall of French ecological tax reform: social acceptability versus political feasibility in the energy tax implementation process" *Energy Policy* **34**, 940-949.

Dresner, S., L. Dunne, P. Clinch, and C., Beuermann (2006) "Social and political responses to ecological tax reform in Europe: an introduction to the special issue" *Energy Policy* **34**, 895-904.

Fehr, E. and K. Schmidt (1999) "A theory of fairness, competition, and cooperation" *Quarterly Journal of Economics* **114**, 817-868.

Fischbacher, U. (2007) "Z-Tree: Zurich toolbox for ready-made economic experiments" *Experimental Economics* **10**, 171-178.

Goode, R. (1984) "Government Finance in Developing Countries" Brookings Institution, Washington DC.

Hsu S.L., J. Walters and A. Purgas (2008) "Pollution tax heuristics: An empirical study of willingness to pay higher gasoline taxes" *Energy Policy* **36**, 3612– 3619.

Johansson-Stenman, O. and J. Konow (2010) "Fair air: Distributive justice and environmental economics" *Environmental and Resource Economics* **46**, 147-166.

Kallbekken, S. and M. Aasen (in press) "The demand for earmarking: results from a focus group study" *Ecological Economics*.

McCaffery, E.J. and J. Baron (2003) "The Humpty Dumpty Blues: Disaggregation Bias in the Evaluation of Tax Systems" *Organizational Behavior and Human Decision Processes* **91**, 230-242.

Sausgruber, R. and J.-R. Tyran (2005) "Testing the Mill hypothesis of fiscal illusion" *Public Choice* **122**, 39-68.

Schuitema G. and L. Steg (2008) “The role of revenue use in the acceptability of transport pricing policies” *Transportation Research Part F* **11**, 221–231.
Smith, V., A.W. Williams, W.K. Bratton and M.G. Vannoni (1982) “Competitive market institutions: Double auctions vs. sealed bid-offer auctions” *American Economic Review* **72**, 58-77.
Thalmann, P. (2004) “The public acceptance of green taxes: 2 million voters express their opinion” *Public Choice* **119**, 179–217.