Tax Morale and (De-)Centralization
- An Experimental Study -

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Abstract

We consider a society composed of two regions. Each of them provides a public good whose benefits reach beyond local boundaries. In case of decentralization, taxes collected by members of a region are spent only on that region's public good. In case of centralization, tax receipts from the two regions are pooled and used to finance both public goods according to the population size of each region. The experiment shows that centralization induces lower tax morale and less efficient outcomes. The reasons are that centralization gives rise to an interregional incentive problem and creates inequalities in income between regions.

Keywords: Tax morale; fiscal federalism; public goods experiments

JEL classification: C91, H26, H41, H70

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I. INTRODUCTION

An important normative principle of fiscal federalism is "fiscal equivalence" (Olson 1969): Those who receive the benefits of a public good should be those who pay for it. Fiscal equivalence calls for a sphere of decentralized levels of government to tailor public output to local public needs (Peltzman and Tideman 1972). However, when the benefits from a given local public good spill over to other regions, a centralized government may in principle constitute a superior regime in order to prevent inefficiently low provision of the public good (Inman and Rubinfeld 1997, Oates 1999).

To provide public supply, modern states do not rely on private voluntary contributions. Rather, to avoid free-riding, they have set up a system of obligatory taxation. Unfortunately, the enforcement of tax compliance is costly and would be ineffective at empirically existing levels if people were merely maximizing expected utility. In this regard, tax-law abiding constitutes a public good in itself with contributions from those who comply and free-riding from those who do not.[1] In spite of individual incentives for noncompliance, empirical evidence shows that people continue to pay taxes (Alm, McClelland and Schulze 1992). This societal phenomenon has been often referred to as "tax morale" (Frey 1997, Feld and Frey 2002, Torgler 2002).

What can explain tax morale? The Internal Revenue Service (1978) has found that there are numerous factors other than economic and deterrence variables that affect individual compliance.[2] Recent theoretical and experimental research suggests the following: (a) overweight of the low probability of audit or extreme risk aversion (Alm, McClelland and Schulze 1992); (b) moral constraints such as feelings of collective blame and shame or aversion against hurting others (Erard and Feinstein 1994, Bosco and Mittone 1997); (c) the existence of a social norm of tax compliance (Alm, McClelland and Schulze 1999); (d) the taxpayer's perception of the fairness of her tax burden (Spicer and Becker 1980, Webley, Morris and Amstutz 1985, Webley, Robben, Elffers and Hessing 1991); (e) social ties between individuals (van Dijk and van Winden 1997).

Over the past decade, several studies have asked whether "tax morale" interacts with political institutions. For example, empirical studies from Switzer-

1. For a comprehensive survey on tax compliance see Andreoni, Erard and Feinstein (1998).
2. That compliance cannot be explained entirely by the level of enforcement is well-acknowledged in the tax compliance literature (Graetz and Wilde 1985, Elffers 1991, Webley, Robben, Elffers and Hessing 1991). Countries set the level of audit and fine so low that most individuals would evade taxes if they were rational, because it is unlucky that cheaters will be caught and penalized (Alm at al. 1992).

land reveal that political participation has a positive effect on various aspects of tax compliance (Pommerehne, Hart and Frey 1994, Pommerehne and Weck-Hannemann 1996, Feld and Frey 2002). These findings are corroborated by laboratory experiments showing that (tax) law abiding behavior depends on people's opportunities to actively participate in the process of political choice (Alm, McClelland and Schulze 1999, Tyran and Feld 2001, Feld and Tyran 2002).

An institutional feature of fundamental empirical relevance is the federal structure of the state. If tax-law abiding is viewed as a public good, a shift from a decentralized to a centralized tax system represents a crucial change in the incentives to pay taxes. The intuition is as follows. Public goods are typically characterized by some degree of locality such that people benefit from the good mainly in the region where this is provided.[3] If taxes are raised and spent locally, tax complying behavior and direct contributions to locally provided public goods are close substitutes in the sense that individual decisions are subject to the same free-riding incentive. On the other hand, if a centralized government mediates locally raised taxes, taxes paid into the central tax pool will typically be spent also in other regions. As a consequence, regions can free ride on the central tax pool, therefore originating a second incentive problem. This may induce taxpayers to exhibit less tax morale under centralized tax structures.

If this argument is empirically valid, important policy implications must be drawn. In particular, the alleged superiority of centralized revenue structures would be seriously flawed if the additional incentive problem connected with centralization erodes tax morale.

In this paper we use experimental methods to test the empirical validity of such additional incentive problem provoked by centralization. Specifically, we investigate whether a centralized system where the total taxes paid by all individuals are used to finance two local public goods leads to less compliance than a decentralized system where taxes collected in one region are used exclusively to finance that region's public good.

Our experimental setting is novel in several ways. First, there is no fine in our treatments, i.e., the audit probability is equal to zero. By this means we exclude risk preferences as explanation for compliance, and can define tax morale as propensity to voluntarily pay taxes in spite of an individual incentive

3. For instance, a program to reduce air pollution can help especially a particular (local) community.

to evade taxation in both the centralized and the decentralized system.[4] Second, besides deciding how much income to report and paying taxes on all reported income, subjects can directly contribute to the public goods. We can thus investigate whether and to which extent, in a centralized structure, individuals substitute direct contributions to the local public good for tax payments. Third, we allow for the benefits from the two local public goods to spill over across regions. We implement these spillovers because in a normative world of fiscal federalism a lack of spillovers would remove any necessity to discuss centralized tax structures at all. Furthermore, the existence of spillovers allows us to test different motivations behind tax compliance behavior.

The experimental results show that the second incentive problem connected with centralization affects individual compliance behavior: Tax morale is decidedly lower when taxes are spent centrally than when they are spent locally. Such negative effect on tax morale is not counterbalanced with higher direct contributions to the public goods. The claimed superiority of a centralized structure when there are interregional spillovers appears therefore weakened by our experimental findings.

II. THE MODEL

Consider a society consisting of two disjoint subgroups, X and Y, with members $i \in X = \{1, ..., m\}$ and $j \in Y = \{m+1, ..., m+n\}$, where $m \geq 2$ and $n \geq 2$. One interpretation is that X and Y are the inhabitants of two regions in a country with citizens 1 to $m+n$. All inhabitants $l = 1, ..., m+n$ receive an (integer) endowment E_l strictly between $\underline{E}$ and $\overline{E}$, where $0 < \underline{E} \leq \overline{E}$. The random move selecting each E_l is independent and uses the identical (uniform) distribution, the so-called iid-case (additional restrictions in brackets refer to our experimental implementation). This feature captures the idea that tax evasion is not directly observable. Knowing only her own E_l, each player l has to make three choices:

1. how much of her endowment to declare for the purpose to be taxed by choosing $e_l \geq 0$, where tax evasion, i.e., $e_l < E_l$, is possible;
2. how much to contribute to public good C by choosing $c_l \geq 0$;
3. how much to contribute to public good D by choosing $d_l \geq 0$.

Choices must satisfy the budget constraint $E_l \geq \tau e_l + c_l + d_l$, where $\tau \in (0, 1)$ denotes the tax rate.

4. Rabin and Thaler (2001) discuss some of the difficulties related to risk perception.

Individuals derive benefits from the two public goods C and D. We allow for these benefits to affect the members of the two subgroups X and Y differently: C is more accessible for X-members whereas D is more accessible for Y-members. An intuitive interpretation is that C and D are two local public goods, one in each region, with spillovers between neighboring regions. We consider two cases, which we label "decentralization" and "centralization".

- *Decentralization*: Here, the local public goods C and D are supported regionally by tax revenues $T_X = \sum_{i=1}^{m} \tau e_i$ and $T_Y = \sum_{j=m+1}^{m+n} \tau e_j$, respectively. Thus, their corresponding size is:

$$C = \sum_{l=1}^{m+n} c_l + T_X \quad \text{and} \quad D = \sum_{l=1}^{m+n} d_l + T_Y.$$

- *Centralization*: In this case, the tax revenues, T, are globally raised so that $T = \sum_{l=1}^{m+n} \tau e_l$. Total revenues T are used proportionally to group size to support the two local public goods whose size therefore is:

$$C = \sum_{l=1}^{m+n} c_l + \frac{m}{m+n} T \quad \text{and} \quad D = \sum_{l=1}^{m+n} d_l + \frac{n}{m+n} T.$$

Individuals' total payoffs can be now written as:

$$\pi_i = E_i - \tau e_i - c_i - d_i + \alpha C + \beta_x D \qquad \forall i \in X \tag{1}$$

and

$$\pi_j = E_j - \tau e_j - c_j - d_j + \beta_y C + \alpha D \qquad \forall j \in Y \tag{2}$$

where $1 > \alpha > \beta_x > \beta_y > 0$ is assumed. The latter inequalities capture two important facts. First, X-members profit more from C and Y-members more from D although, due to $\beta_x, \beta_y > 0$, all individuals gain from both public goods. Second, due to $\beta_x > \beta_y$, the linkage to the neighboring public good is weaker for Y-members than for X-members.

Because of $\alpha < 1$, both in case of centralization and in case of decentralization, each player l would maximize her own payoff by choosing $c_l^* = 0$, $d_l^* = 0$ and $e_l^* = 0$. General opportunism in this sense implies $C = 0$ and $D = 0$, so that $\pi_l^* = E_l$ for all $l = 1, ..., m+n$.

If, however, the usual assumptions of public goods experiments are additionally imposed, namely $m\alpha + n\beta_y > 1$ and $m\beta_x + n\alpha > 1$, all individuals could be better off by directly contributing or, at least, by paying taxes properly.

To illustrate this, assume that all X-members set $c_i^+ = E_i$, all Y-members set $d_j^+ = E_j$, and everybody cheats on taxes, i.e., $e_l = 0$ for all $l = 1, ..., m+n$. Then the individual payoffs are:

$$\pi_i^+ = \alpha \sum_{l=1}^{m} E_l + \beta_x \sum_{l=m+1}^{m+n} E_l \qquad \forall i \in X$$

and

$$\pi_j^+ = \beta_y \sum_{l=1}^{m} E_l + \alpha \sum_{l=m+1}^{m+n} E_l \qquad \forall j \in Y.$$

Thus, the total welfare is

$$\sum_{l=1}^{m+n} \pi_l^+ = (m\alpha + n\beta_y) \sum_{l=1}^{m} E_l + (m\beta_x + n\alpha) \sum_{l=m+1}^{m+n} E_l \tag{3}$$

which, due to $m\alpha + n\beta_y > 1$ and $m\beta_x + n\alpha > 1$, exceeds the total welfare

$$\sum_{l=1}^{m+n} \pi_l^* = \sum_{l=1}^{m+n} E_l \tag{4}$$

in case of general opportunism.

On the other hand, if nobody directly contributes to the public goods but all individuals pay taxes properly, i.e., $e_l = E_l$ for all $l = 1, ..., m+n$, the result in case of centralization would be:

$$\pi_i = (1-\tau)E_i + \tau \Big[\alpha \frac{m}{m+n} + \beta_x \frac{n}{m+n}\Big] \sum_{l=1}^{m+n} E_l \qquad \forall i \in X$$

and

$$\pi_j = (1-\tau)E_j + \tau \Big[\beta_y \frac{m}{m+n} + \alpha \frac{n}{m+n}\Big] \sum_{l=1}^{m+n} E_l \qquad \forall j \in Y$$

yielding a total welfare of:

$$\sum_{l=1}^{m+n} \pi_l = \Big(1 - \tau + \tau \Big[(m\alpha + n\beta_y)\frac{m}{m+n} + (m\beta_x + n\alpha)\frac{n}{m+n}\Big]\Big) \sum_{l=1}^{m+n} E_l. \tag{5}$$

Again, in view of $m\alpha + n\beta_y$ and $m\beta_x + n\alpha$ exceeding 1, the square bracket and thus the coefficient of $\sum_{l=1}^{m+n} E_l$ on the right side of Eq. (5) are larger than 1

and, therefore, larger than the welfare in case of general opportunism as defined by Eq. (4). Hence, the total welfare could be already increased if all members of the society were paying their taxes properly.

Note, however, one major difference between our scenario and typical public goods settings. In our model, if all individuals stick to the efficiency benchmark someone may be worse off than in case of universal free-riding. To demonstrate this, assume that $\underline{E}$ is close to 0, E_l is close to $\underline{E}$ for all $l \neq i$ while E_i is close to $\overline{E}$. In such an extreme case, individual i would be the only essential contributor. Choosing $c_i^+ = E_i$ would still enhance total welfare but, due to $\alpha < 1$, player i would suffer from her choice. Hence, heterogeneity of endowments questions the mutual ex post-profitability of efficiency benchmarks.

III. EXPERIMENTAL PROCEDURES AND HYPOTHESES

In the experiment we consider groups (i.e., societies) with six individuals. Each group comprises two subgroups, X and Y, of size three each ($n = m = 3$). This implies $\frac{m}{m+n} = \frac{n}{m+n} = \frac{1}{2}$. Hence, in case of centralization, the total tax revenue is equally distributed between the two public goods, C and D.

There are two basic treatments, which differ only with respect to the levy and disbursement of taxes as explained in Section II. In DECEN, taxes are raised locally and spent exclusively on one's own regional public good. In CEN, taxes are raised globally and receipts are split between regions on a per capita basis.

Groups interact for a total of 32 rounds in a stranger design (i.e., groups are randomly assembled every round). Subjects are informed of this. To collect more than just one independent observation per session subjects are rematched within matching groups. Subjects are either in subgroup X or in subgroup Y in all rounds. That is, an X-member of the group remains an X-member throughout the experiment and, likewise, a Y-member of the group is always a Y-member. Henceforth, the X-members of the group will be addressed as X-types and the Y-members as Y-types.

An experimental session consists of two subsequent phases of 16 rounds each. Each phase employs either the CEN-treatment or the DECEN-treatment (within-subjects factor) with the order of treatments as between-subjects factor: In half of the sessions subjects experience CEN in phase 1 (i.e., in the first 16 rounds) and DECEN in phase 2 (i.e., in the last 16 rounds) while in the remaining sessions subjects experience the treatments in the reverse order, i.e., DECEN in phase 1 and CEN in phase 2. Henceforth, we will refer

to the order CEN-DECEN as $Order = 0$ and to the order DECEN-CEN as $Order = 1$. The instructions distributed at the beginning of the experiment inform participants only about the rules of the first treatment that they encounter. Instructions about the second treatment are distributed before the second phase.

In each period, each subject receives an endowment of E tokens and must first of all decide how much of E she wants to report for the purpose to be taxed. The after-tax endowment is calculated by computer, and then the subject specifies her contributions to the two public goods, C and D. Finally, the subject learns about her period-payoff.

The lower and upper bounds, $\underline{E}$ and $\overline{E}$, of the uniform distribution from which endowments are randomly selected amount to 10 and 110 points, respectively. As for the other parameters values, we chose: $\alpha = 0.6$, $\beta_x = 0.3$, $\beta_y = 0.1$ and $\tau = 0.25$. Since $m = n = 3$, the restrictions for uniqueness of solution (in strictly undominated strategies) at $c_l^* = d_l^* = e_l^* = 0$ for all $l = 1, ..., 6$ (namely, $0 < \beta_y = 0.1 < \beta_x = 0.3 < \alpha = 0.6 < 1$) and for efficiency enhancing full contributions (namely, $1 < m\alpha + n\beta_y$ and $1 < m\beta_x + n\alpha$) turn into $1/3 < \alpha + \beta_y = 0.7$ and $1/3 < \alpha + \beta_x = 0.9$. These restrictions are satisfied by our parameterization.

Under the null hypothesis of opportunistic and strictly self-interested behavior, subjects would not contribute privately to the public goods nor would they pay taxes: $c_i = d_i = e_i = 0$. There is, however, abundant empirical evidence that, against individual incentives to free-ride, people contribute quite substantially. Moreover, laboratory experiments have established that economic incentives influence contribution behavior. For instance, Isaac, Walker and Thomas (1984) provide evidence that increasing the marginal per capita return increases the rate of contribution. In line with this argument, *Table 1* shows the partial first derivatives of individual payoffs (as given in Eqs. (1) and (2)) with respect to direct contributions and tax-payments separately for players' types (X vs. Y) and experimental treatments (CEN vs. DECEN). In the table, X_{CEN} (X_{DECEN}) stands for X-types in CEN (DECEN). Likewise, Y_{CEN} (Y_{DECEN}) stands for Y-types in the respective treatment. Column (1) shows the derivatives of π_l with respect to tax-payment. Columns (2) and (3) contain the derivatives of π_l with respect to private contributions, c_l and d_l.

The main purpose of this study is to evaluate how the two experimental treatments (CEN vs. DECEN) affect "tax morale". By "tax morale" we mean people's propensity to voluntarily pay taxes.[5] Here, tax morale is captured by

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Table 1

Partial Derivatives With Respect to Choice Variables

	(1) $(\partial\pi_l/\partial e_l)/\tau$	(2) $\partial\pi_l/\partial c_l$	(3) $\partial\pi_l/\partial d_l$
X_{CEN}	$-1+\alpha\frac{m}{m+n}+\beta_x\frac{n}{m+n}$	$-1+\alpha$	$-1+\beta_x$
X_{DECEN}	$-1+\alpha$	$-1+\alpha$	$-1+\beta_x$
Y_{CEN}	$-1+\beta_y\frac{m}{m+n}+\alpha\frac{n}{m+n}$	$-1+\beta_y$	$-1+\alpha$
Y_{DECEN}	$-1+\alpha$	$-1+\beta_y$	$-1+\alpha$

Note: $\alpha=0.6$, $\beta_x=0.3$, $\beta_y=0.1$, $\tau=0.25$, $\frac{m}{m+n}=\frac{n}{m+n}=\frac{1}{2}$.

the choice variable e_l. Column 1 of *Table 1* makes it evident that individual marginal payoffs with respect to paying taxes differ according to treatment. In particular, because of our parameter restrictions (i.e., $\alpha > \beta_x > \beta_y$), for both X- and Y-types marginal payoffs are smaller in CEN than in DECEN. This makes good sense: If taxes are raised and spent regionally, as in DECEN, paying taxes and directly contributing to one's own regional public good are equivalent in the sense that the two choices yield the same marginal payoff (compare X_{DECEN} in column (1) with X_{DECEN} in column (2), and Y_{DECEN} in column (1) with Y_{DECEN} in column (3)). On the contrary, in CEN, paying taxes becomes individually more costly than directly contributing to one's own regional public good. A centralized system raises indeed an additional incentive problem: If the inhabitants of one region report their income properly, the other region's members can free-ride on the share of the total tax revenues that their own regional public good receives from central redistribution. Therefore, we expect subjects in CEN to report less income than subjects in DECEN.

Hypothesis 1 *Tax morale is lower, i.e., there is more underreporting of own income, in CEN than in DECEN.*

The distinction between two types of players allows us to make a further inference. As compared to the Y-types, the X-types receive higher benefits from their neighboring public good. Consequently, the additional incentive problem faced by the taxpayer under a centralized system is smaller for the X-types than for the Y-types: If the Y-types pay taxes properly and the X-types free-ride, the X-types would bear no costs and share higher benefits from the public goods than if the roles of taxpayers and free-riders were exchanged.

Deci and Ryan (1985) and Frey (1997) define tax morale as an "intrinsic motivation to pay taxes".

On the basis of a comparison between X_{CEN} and Y_{CEN} in column (1) of *Table 1*, we predict a more pronounced treatment effect for Y-types. We state this prediction as a separate hypothesis:

Hypothesis 2 *Treatment effects on income declarations are more pronounced for Y-types than for X-types.*

The next hypothesis focuses on players' contribution behavior. If economic incentives matter, members of a region contribute relatively more to their own region's public good than to the neighboring region's one, i.e., X- (Y-)types contribute more to C (D) than to the alternative public good. As marginal private payoffs are kept constant across treatments for both types (cf., columns (2) and (3) in *Table 1*; first two rows for X-types and last two rows for Y-types), we would expect no differences in the amount contributed to the local public good neither between treatments nor between types. It may be argued that the incentive problem related to tax-payments in the centralized system could induce individuals to substitute direct contributions for taxes.[6] In this case, direct contributions would be higher in CEN than in DECEN. However, since this difference in contributions is not supported by marginal incentives (as reported in *Table 1*), we formulate our next hypothesis as:

Hypothesis 3 *Subjects' direct contributions to public supply are not affected by treatment conditions.*

As derived in Section II, lower tax morale would induce less efficiency under a centralized tax regime. Therefore, Hypotheses 1 and 3 jointly imply lower efficiency in CEN than in DECEN.

IV. EXPERIMENTAL RESULTS

The computerized experiment was conducted at the experimental laboratory of the Max Planck Institute in Jena (Germany) in November 2002. The experiment was programmed and performed with the z-Tree software (Fischbacher

6. A similar substitution would be, for instance, carried out by a person with altruistic preferences whose objective is to maximize total welfare (Palfrey and Prisbrey 1997). Alternatively, preferences for contributing may be subject to the "neutrality theorem", according to which government contributions to public goods, funded by taxation, should completely crowd out private contribution (Warr 1982, Bergstrom, Blume and Varian 1986, Bernheim 1986). A necessary condition for complete crowding out is, however, that the equilibrium is interior, which is not our case. Furthermore, the experimental work of Andreoni (1993) has shown that crowding out of direct contributions by taxes is incomplete.

1999). Participants were undergraduate students from different disciplines at the University of Jena. After being seated at a computer terminal, participants received written instructions. Understanding of the rules was assured by a control questionnaire that subjects had to answer before the experiment started. English translations of instructions and control questionnaire are included in the Appendix.

Overall, we ran 6 sessions with a total of 132 subjects. Each session took about 75 minutes. The average earning per subject was €11 (including a show-up fee of €2.5). In total, we distinguished ten matching groups,[7] guaranteeing 5 independent observations for each order (0 vs. 1).

Table 2

Average of Relative Income Declarations and Direct Contributions

Session	No. of Subjects	Choice	DECEN			CEN		
(Order)	(Matching Groups)	Variable	X	Y	All	X	Y	All
		$\bar{e}$	52.71	43.15	47.93	41.10	35.94	38.51
I-III (0)	66 (5)	$\bar{c}$	40.54	3.77	22.16	45.55	5.80	25.67
		$\bar{d}$	8.29	40.42	24.35	6.55	47.37	26.96
		$\bar{e}$	60.81	36.43	48.62	32.13	24.56	28.34
IV-VI (1)	66 (5)	$\bar{c}$	39.17	3.75	21.46	34.12	1.76	17.94
		$\bar{d}$	4.91	42.54	23.72	5.54	34.17	19.86
		$\bar{e}$	56.76	39.79	48.28	36.61	30.25	33.43
ALL	132 (10)	$\bar{c}$	39.86	3.76	21.81	39.83	3.78	21.81
		$\bar{d}$	6.60	41.48	24.04	6.05	40.77	23.41

Table 2 summarizes our results. The table presents the average income declarations, $\bar{e}$, and the average direct contributions to the public goods, $\bar{c}$ and $\bar{d}$. The averages are calculated by dividing the individual declared income, e_l, and the individual contributions, c_l and d_l, by the individual endowment, E_l, and then averaging across subjects and periods. *Table 2* is split in three panels that correspond to the order in which the treatments were played. In sessions I to III (upper panel), subjects encountered the treatments in the order labelled 0 (i.e., first CEN and then DECEN). In sessions IV to VI (middle panel), subjects experienced the treatments in the reverse order (which we call $Order = 1$).

With respect to tax morale, *Table 2* shows that subjects declare less income in CEN than in DECEN. For instance, the first row associated with the choice variable $\bar{e}$ reveals that X-types in sessions I to III declare on average 52.71% of

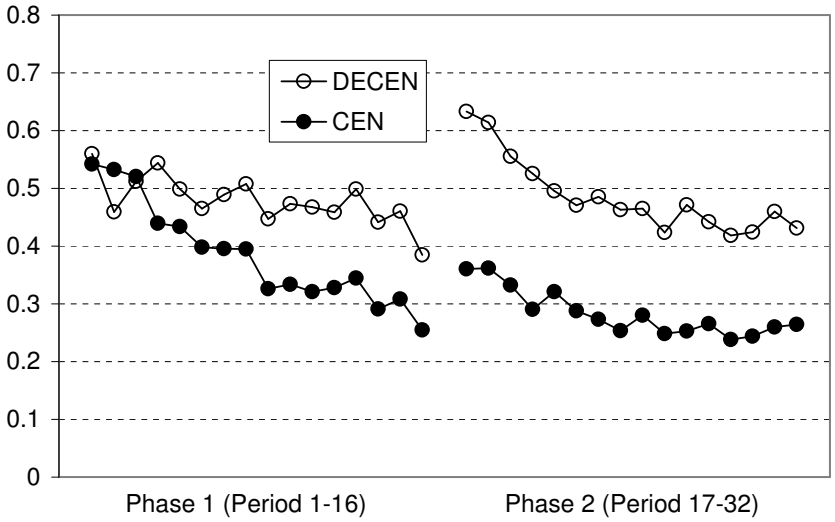
7. Eight matching groups consisted of 12 subjects and two of 18 subjects. The reason is that in sessions III and VI only 18 of the 24 invited people showed up.

their endowment in DECEN, which compares to an average of only 41.10% in CEN. A similar result holds for participants in sessions IV to VI, so that total average declarations in DECEN clearly exceed those in CEN.

Figure 1 provides a more detailed picture of the average amount of compliance by period for the two treatments and for both orders.

Figure 1

Average Relative Income Declarations Over Periods



Regardless of the order of treatments, income declarations in DECEN are substantially above those in CEN. In phase 1, average declarations start out at the same level and quickly diverge as the experiment proceeds. Thus, the observed treatment effect is not induced by some unintended effects of the experimental procedures, but subjects systematically react to the actual incentives provided by our treatments. In phase 2, a "restart effect" (cf., Andreoni 1988) appears to strengthen the treatment effect under $Order = 0$ (i.e., CEN-DECEN) and to mitigate it under the reverse order. Furthermore, in each phase the amount of compliance decays with repetitions. This pattern is in line with that of previous public goods experiments.[8] The difference in compliance behavior between DECEN and CEN are, nevertheless, remarkable and do not seem to narrow as the experiment proceeds. This evidence supports Hypothesis 1.

Quite unexpectedly (against Hypothesis 2), according to *Table 2*, treatment effects are less pronounced for Y-types than for X-types. From the lower panel

8. For a comprehensive survey on public goods experiments see Ledyard (1995).

of the table, for instance, we see that the pooled (across sessions) income declaration rates drop by 36% (going from 56.76% under DECEN to 36.61 under CEN) for the X-types and only by 24% (from 39.79% under DECEN to 30.25% under CEN) for the Y-types.

The results relative to tax morale can be summarized by:

Result 1 *In accordance with Hypothesis 1, income declarations are lower in CEN than in DECEN. Contrary to Hypothesis 2, treatment effects are more pronounced for X-types than for Y-types.*

More stringent support for Result 1 comes from non parametric statistical tests comparing income declarations both across and within subjects. A Wilcoxon rank-sum test (two-sided) comparing independent observations averaged across matching groups reveals that X-types report significantly higher percentages of their income in DECEN than in CEN ($p = 0.028$). The same p-value is obtained for the first phase (periods 1 to 16) and for the second phase (periods 17 to 32). The respective differences for Y-types, though following the same direction, are insignificant both in phase 1 ($p = 0.754$) and in phase 2 ($p = 0.251$). To clarify whether this lack of significance is just a matter of statistical indeterminacy due to small samples, we conducted a test using individual Y-types' data averaged across periods.[9] The results of the test show that treatment effects on Y-types' tax compliance behavior are rather small in phase 1 ($p = 0.131$) but very strong in phase 2 ($p = 0.002$).

Statistical comparisons within subjects confirm that the DECEN income declarations by the X-types exceed significantly their CEN income declarations in both phases ($p = 0.043$ according to a rank-sum test, two-sided, based on independent matching groups). For the Y-types results are less clear cut ($p = 0.893$ in phase 1 and $p = 0.080$ in phase 2).

Turning to subjects' contribution behavior, members of a region contribute substantially to their own region's public good with average contribution rates ranging from 34.12% to 47.37% (see *Table 2*). In accordance with individual incentives, subjects contribute little to the other region's public good with rates between 1.76% and 5.80%.

Next we ask whether direct contributions to public supply convey any treatment effects. Considering data pooled across sessions, the lower panel of *Table 2* reveals that the averages of contributions (normalized by endowments) are essentially unaffected by treatment conditions. To corroborate statistically this

9. Notice that these data are not statistically independent within groups.

finding, we compare direct contributions across subjects.[10] In sessions I to III, contributions to the local public good by both X-types and Y-types are higher in CEN than in DECEN (see the 2nd and 3rd row in *Table 2*), although the difference is not significant ($p = 0.602$ and $p = 0.175$ for X- and Y-types, respectively; Wilcoxon rank-sum test, two-sided, using matching groups as independent observations). In sessions IV to VI, contributions to the local public good by both types are lower in CEN than in DECEN (see the 5th and 6th row in *Table 2*). Again, the difference is not significant ($p = 0.602$ and $p = 0.251$, respectively). As the sign of the differences changes with the order of treatments, we conclude that differences, if any, are caused by the order in which treatments were played (with higher contributions in the treatment faced first), but cannot be attributed to the different treatment conditions.

Result 2 *There are no treatment effects on subjects' direct contributions to public goods.*

Since there are no treatment effects on direct contributions but tax compliance is higher under the decentralized tax structure, efficiency should be higher in DECEN than in CEN. This can be rigorously corroborated via statistical tests. Subjects' payoffs represent a straightforward measure of efficiency in our design. A Wilcoxon signed-rank test comparing payoffs averaged across periods for all 132 subjects reveals that payoffs in DECEN are significantly higher than payoffs in CEN ($p = 0.006$). Differentiating between types, we find that the X-types earn approximately 17% more in DECEN than in CEN (115.8 vs. 99.3 on average per period). According to a Wilcoxon signed-rank test using as observations the 10 independent matching groups, the difference in earnings between treatments is significant at the one percent level ($p = 0.005$). Regarding the Y-types, they earn approximately 13% more in DECEN than in CEN (109.0 vs. 96.3; $p = 0.022$). Hence, we can state:

Result 3 *Outcomes are more efficient in DECEN than in CEN.*

To further corroborate our previous results, *Table 3* reports the results of an OLS regression. To account for statistical dependence between matching groups, we calculated robust standard errors adjusted for clustering on groups. We included in the regression the individual value of the choice variables in the previous period $t - 1$.

10. The within-subjects statistical analysis provides the same qualitative results.

The independent variable *Tmt* is a dummy taking value of zero for DECEN and one for CEN. *Tmt* is significantly negative for income declarations, meaning that subjects declare less income in CEN. There are no treatment effects for direct contributions to the public goods. The dummy variable *Type* is zero for X-types and one for Y-types. As already summarized by Result 2, treatment effects on tax morale are smaller for Y-types than for X-types, although the effect is insignificant in the regression. Regarding the dependent variables c_l and d_l, economic incentives have a clear and significant effect on both types in the sense that subjects contribute more to their own region's public good than

Table 3

OLS Regression With Robust Standard Errors

	Dependent variable in period t		
	e_l	c_l	d_l
Independent variable	Coefficient (robust std. error)		
Constant	0.189***	0.208***	0.076***
	(0.027)	(0.024)	(0.015)
$e_l(t-1)$	0.728***	-	-
	(0.028)		
$c_l(t-1)$	-	0.632***	-
		(0.031)	
$d_l(t-1)$	-	-	0.688***
			(0.046)
Tmt	-0.051***	0.002	-0.002
	(0.009)	(0.006)	(0.005)
Type	-0.035	-0.130***	0.108***
	(0.023)	(0.019)	(0.108)
Endow	-0.000	-0.001**	-0.001***
	(0.000)	(0.000)	(0.000)
Order	-0.018	-0.013	-0.010
	(0.017)	(0.011)	(0.011)
Period	-0.001	-0.001***	-0.001**
	(0.000)	(0.000)	(0.000)
	$N \times t = 4092$	$N \times t = 4092$	$N \times t = 4092$
	F(6, 9) = 591.10***	F(6, 9) = 1103.31***	F(6, 9) = 1880.84***
	R^2=0.56	R^2= 0.63	R^2=0.65

Note: Significance levels: $***\leq 0.01$, $**\leq 0.05$, $*\leq 0.1$.

to the neighboring region's public good.

The variable *Endow* refers to absolute endowment. Relative income declarations do not depend on absolute endowment. Small and significantly negative effects can be found for direct contributions, implying that high endowments induce slightly less direct contributions to the public goods. This finding could be expected from our discussion in Section II.

The variables *Order* and *Period* capture respectively how behavior changes with the order of treatments and over periods. Order effects are insignificant for all three choice variables. The coefficient on *Period* is negative, indicating that cooperation decays over time. To conclude, the regression analysis confirms all our previous results and is in line with well-established findings from previous experimental research on public goods.

V. DISCUSSION OF THE RESULTS

In Sections II and III we focused exclusively on the effects of individual (marginal) incentives on tax-declarations and direct contributions to the public goods. While our data confirms Hypotheses 1 and 3, it rejects Hypothesis 2. This indicates that some other motivation, different from pure opportunism, shapes individuals' behavior.

A plausible candidate for explaining behavior has been suggested by Fehr and Fischbacher (2003). In line with recent fairness research,[11] the authors show that the members of a polity are concerned with income inequalities across polities, where the inequalities arise from some free-riding polities. Interestingly, they find that a centralized tax system is more efficient than a decentralized one when there is a global public good and several local polities.

In this section we will show that a centralized tax system is "less fair" (i.e., induces more income inequalities) than a decentralized system when taxes to support local public goods are raised globally. In the following we capture the notion of inequality by absolute differences in payoffs. Starting from the CEN-treatment, assume that, *ceteris paribus*, subject i of type X increases her own tax payment by one unit. This person loses $\frac{m}{m+n}\alpha + \frac{n}{m+n}\beta_x - 1$ (see *Table 1*), but each inhabitant, $-i$, of her own region gains $\frac{m}{m+n}\alpha + \frac{n}{m+n}\beta_x$ and each inhabitant, j, of the neighboring region gains $\frac{n}{m+n}\alpha + \frac{m}{m+n}\beta_y$. Consequently, the absolute difference between the payoff of taxpayer i and the payoff of any individual within her own region changes by $\Delta^{IN} = (\pi_{-i} - \pi_i) = 1$. Similarly, the

11. For a survey see, e.g., Fehr and Schmidt 2002.

change in the absolute payoff difference between subject i and any individual outside her own region is $\Delta^{OUT} = (\pi_j - \pi_i) = 1 + \frac{n}{m+n}\beta_y - \frac{m}{m+n}\beta_x$.

Table 4 summarizes the marginal effects of paying taxes on the absolute payoff differences Δ^{IN} and Δ^{OUT} under both tax policies (CEN vs. DECEN) and for both taxpayer-types. An increase of tax-payment by one unit always increases the absolute payoff difference inside one's own region by one unit, regardless of the taxpayer's type and the treatment. In contrast, the absolute payoff differences with respect to members of the neighboring region depend on the type of the taxpayer and the treatment. From the rightmost column of *Table 4*, Δ^{OUT} in case of DECEN is smaller than Δ^{OUT} in case of CEN for the X-types if $\alpha > \frac{m}{m+n}(\beta_x + \beta_y)$ and for the Y-types if $\alpha > \frac{n}{m+n}(\beta_x + \beta_y)$. If these two inequalities hold (as it is the case for our experimental parameters), then declaring taxes is more fair (i.e., causes less inequality in payoffs across players) in DECEN than in CEN. It follows that, in our study, treatment effects can be explained by self-regarding incentives as well as by a potential aversion against unequal payoffs.

Table 4

Marginal Effects of Paying Taxes on Absolute Payoff Differences

	$\Delta^{IN} = \pi_{-i} - \pi_i$	$\Delta^{OUT} = \pi_j - \pi_i$
X_{CEN}	1	$1 + \frac{n}{m+n}\beta_y - \frac{m}{m+n}\beta_x$
X_{DECEN}	1	$1 + \beta_y - \alpha$
Y_{CEN}	1	$1 + \frac{m}{m+n}\beta_x - \frac{n}{m+n}\beta_y$
Y_{DECEN}	1	$1 + \beta_x - \alpha$

To provide a stringent test for this claim, we need to disentangle the effects of self-regard from those of other-regarding concerns. Our design enables us to do so by taking into account how inequality averse types would behave as opposed to self-regarding types in DECEN. Because of $\beta_x > \beta_y$, Δ^{OUT} for X_{DECEN} is smaller than Δ^{OUT} for Y_{DECEN}. For our parameterization this difference is quite substantial. For instance, if an X-type pays 25 points of taxes, this increases the income of a Y-type by 2.5 points. If the same amount of taxes is paid by a Y-type, every X-type gains three times as much, namely 7.5 points. Other-regarding Y-types may perceive this as being unfair and report less income than X-types. Thus, in a decentralized tax system, inequality averse Y-types should declare less income (and pay less taxes) than X-types. In contrast, since the marginal monetary incentives with respect to tax-payment are identical for X_{DECEN} and Y_{DECEN} (see column (1) of *Table 1*), merely

self-regarding preferences would predict no divergent behavior between types. Hence, comparing tax declarations of types in DECEN allows us to distinguish between self-regard and fairness concerns.

We find that Y-types in DECEN declare on average 30% less income to be taxed than X-types (39.79 vs. 56.76, cf. *Table 2*). The difference is highly significant ($p = 0.004$ according to a Wilcoxon rank-sum test based on independent matching groups). We conclude that inequality aversion seems to be a valid and important concern. Therefore, fairness is an additional argument for lower tax morale when regional public goods are funded by centrally raised taxes rather than by decentralized tax structures. We regard this as an important insight. As shown by Fehr and Fischbacher (2003), fairness renders centralization more efficient when global public goods are provided locally. Our study shows that centralization fares worse when local public goods are funded via globally raised taxes.

VI. CONCLUSIONS

Tax morale is regarded as a plausible explanation for individuals' tax compliance often without discussing or even considering which conditions may affect it. The federal structure of the state may be interacting with the propensity of people to honestly pay taxes.

In this paper, we have provided experimental evidence on the impact of different federal tax and spending regimes on tax morale. In line with previous empirical research, we find that people exhibit a great deal of tax morale: Even with no chance of detection and no penalty, individuals pay substantial amounts of taxes. Moreover, our results suggest that the institutional framework shapes tax morale in a considerable way.

In our experiment, there are two regional public goods and the inhabitants of each region can contribute to the provision of the public goods either directly (via private contributions) or indirectly (via taxes). We find that people's propensity to pay taxes is higher in a decentralized tax structure, in which taxes collected in one region are spent exclusively on that region's public good, as compared to a centralized tax structure, in which taxes paid in the two regions are pooled and spent on both public goods on a per capita basis. As the different tax structures do not affect private contributions, it turns out that decentralization is the most efficient institution when local public goods must be funded by taxes.

We provide two main explanations why people show a higher tax morale if their taxes are spent only on their own regional public goods. First, while in case of centralization tax fraud allows the inhabitants of one region to free ride on the other region's tax payments, this interregional incentive problem is absent in case of decentralization. Second, centralization creates more inequalities in income across regions, so that fairness-minded individuals refrain from paying taxes because of inequality aversion. Whilst both motives are in force and could explain our results, our design was not intended to quantify their relative importance. What clearly emerges from our experiment is that the often claimed superiority of a centralized government in case of externalities across regions needs to be reconsidered.

APPENDIX

Sample Instructions (Originally in German)

General Instructions: Thank you for participating in the experiment. You receive €2.5 for having shown up on time. If you read these instructions carefully and follow all the rules, you can earn more. The €2.5 and all additional amount of money will be paid to you in cash immediately after the experiment. During the experiment we shall not speak of euros but rather of points. Points are converted to euros at the following exchange rate: 100 Points = 25 Cents (€0.25).

It is forbidden to speak to other participants during the experiment. If you have any questions, please ask us. We will gladly answer your questions individually. It is very important that you follow this rule, otherwise we will have to exclude you from the experiment and from all payments.

The experiment is divided into periods. In total there will be 16 periods. In every period you are randomly matched into groups of six persons. The composition of your group will randomly change after each period. That is, your group members will be different from one period to the next. The identity of your group members will not be revealed to you at any time.

In your group there will be 3 members of type X and 3 members of type Y. You will learn your role at the beginning of the experiment. Roles do not change, i.e., **you will keep your role over the entire experiment**.

Detailed Instructions: At the beginning of each period, each participant receives a number of points. In the following we refer to this as **your endowment**. For each participant the endowment is a number randomly determined between 10 and 110 points. It holds that any number between 10 and 110 is equally likely. You will learn about your endowment in every period. You will not know the endowment of the other participants nor do the other participants know your endowment. In each period, you as well as the other five participants in your group take two decisions:

1. You have to decide **how much of your endowment you want to declare for the purpose to be taxed**. The tax is imposed in the following way: **t = 1/4 = 25 percent of taxes** are deducted from the endowment you declare. No taxes are deducted from the endowment you do not declare. The taxes are used in the following way: Those paid by group members of **type X** are used for **project X**. Those paid by group members of **type Y** are used for **project Y**.

[*In the CEN-treatment this paragraph was replaced by*: Half (1/2 = 50 percent) of the taxes that are paid by all six group members are used for **project X**. Half are used for **project Y**.]

2. Furthermore, you have to decide **how much of your remaining endowment you want to contribute directly to the two projects X and Y**. Whatever you do not contribute, you **keep for yourself ("points you keep")**. The sum of all taxes used for project X and all direct contributions to X is called **X-amount**. The sum of all taxes used for project Y and all direct contributions to Y is called **Y-amount**. In every period your income consists of two parts:

(1) The "points you keep".
(2) The **"income from the projects"**. This income is determined as follows:

Income from the projects for **X-participant**	**0.6 × [X-amount] + 0.3 × [Y-amount]**
Income from the projects for **Y-participant**	**0.1 × [X-amount] + 0.6 × [Y-amount]**

The income from the projects is determined in the same way for **all X-participants**; this means that they all receive the same income from the projects. If, for example, the X-amount is 100 points and the Y-amount is 100 points, all participants of type X receive $(0.6 \times 100) + (0.3 \times 100) = 90$ points.

Likewise, the income from the projects is determined in the same way for **all Y-participants**; this means that they all receive the same income from the projects. If, for example, the X-amount is 100 points and the Y-amount is 100 points, all participants of type Y receive $(0.1 \times 100) + (0.6 \times 100) = 70$ points.

The points that a participant of type X declares for the purpose to be taxed increase the **X-amount**. **The points that a participant of type Y declares** for the purpose to be taxed increase the **Y-amount**. If you are a participant of **type X** and declare, for example, 100 points, this increases the X-amount by 25 points. As a consequence, the income of each participant of type X increases by $0.6 \times 25 = 15$ points, and the income of each participant of type Y increases by $0.1 \times 25 = 2.5$ points. If you are a participant of **type Y** and declare, for example, 100 points, this increases the Y-amount by 25 points. As a consequence, the income of each participant of type Y increases by $0.6 \times 25 = 15$ points, and the income of each participant of type X increases by $0.3 \times 25 = 7.5$ points. Similarly, you profit from the taxes paid by the others.

[*In the CEN-treatment this paragraph was replaced by*: **The points that a participant declares** for the purpose to be taxed increase the **X-amount and the Y-amount**. For example, if you declare 100 points, this raises taxes by 25 points. Half these taxes are used for increasing the X-amount by 12.5 points and half for increasing the Y-amount by 12.5 points. As a consequence, the income of each participant of type X increases by $(0.6 \times 12.5) + (0.3 \times 12.5) = 11.25$ points, and the income of each participant of type Y increases by $(0.1 \times 12.5) + (0.6 \times 12.5) = 8.75$ points. Similarly, you profit from the taxes paid by the others.]

If you **directly contribute one point to project X**, the X-amount increases by one point. As a consequence, the income of each participant of type X increases by 0.6 points, and the income of each participant of type Y increases by 0.1 points. Hence, there are $(0.6 \times 3) + (0.1 \times 3) = 2.1$ more points earned from project X. Similarly, you profit from the direct contributions to project X by the others.

If you **directly contribute one point to project Y**, the Y-amount increases by one point. As a consequence, the income of each participant of type X increases by 0.3 points, and the income of each participant of type Y increases by 0.6 points, so that there are $(0.3 \times 3) + (0.6 \times 3) = 2.7$ more points earned from project Y. Similarly, you profit from direct contributions to project Y by the others.

The **points you keep** are your **endowment *minus* your tax payments *minus* your direct contributions** to the two projects. Each point that you keep for yourself raises "points you keep" by one point.

You will take your decisions by computer. At the beginning of every period you will see the following input screen (*original instructions included a screen-figure here*).

The number of the period appears in the top left corner of the screen. In the top right corner, you can see how many more seconds remain to take your decision. The first line shows **Your Endowment** in the current period (here: 66). In the input field below you must enter the amount of points you want to declare for the purpose to be taxed (**Your Declaration**).

After clicking the OK-button, a second input screen will appear (*original instructions included a screen-figure here*). The first line shows your after-tax endowment (here: 51). In this example, the participant declared 60 out of 66 points for the purpose to be taxed. From these 60 points, 60×0.25 points were deducted as taxes (66 - 15 = 51). In the two fields below you must enter how much of your remaining endowment you want to contribute directly to project X (**Your direct contribution to project X**) and to project Y (**Your direct contribution to project Y**). Please note: The sum of your direct contributions must not exceed your after-tax endowment.

Finally, you will see a result screen (*original instructions included a screen-figure here*). The first line shows again your endowment. The second line shows your tax payment. The next two lines show how many points you have contributed directly to project X (here: 20) and project Y (here: 20). The two lines in the center show the X-amount and Y-amount (here: 176 and 47). Finally, you see your period income (here: 131).

The above example refers to a **participant of type X**. To illustrate once more, for a participant of this type the income is calculated in the following way: Your tax-payments and your direct contributions to projects X and Y are deducted from your endowment. Therefore, the "points you keep" are: 66 - 15 - 20 - 20 = 11. By adding your income from the projects: $(0.6 \times 176) + (0.3 \times 47) = 119.7$, your period income is 11 + 119.7 = 131 points.

Assume now that you were a **participant of type Y**. Your income would be calculated as follows: Again, your tax-payments and your direct contributions to projects X and Y are deducted from your endowment. Therefore, the "points you keep" are: 66 - 15 - 20 - 20 = 11. Your income from the projects would now be: $(0.1 \times 176) + (0.6 \times 47) = 45.8$. This results in a period income of 11 + 45.8 = 57 points.

Please remain seated quietly until the experiment starts. If you have any questions please raise your hand.

Control Question: *At the start of the experiment subjects learned their types and the X-types [Y-types in parentheses] had to answer the following question.*

Please answer the following question. A wrong answer has no consequences. If you have any questions, please, raise your hand.
Suppose your endowment is 50 points. You declare 40 points to be taxed. You contribute 20 [0] points directly to project X. You contribute 0 [20] points directly to project Y. The X-amount is 100 points. The Y-amount is 100 points. What is your income in this case?

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