

Tax morale and (de-)centralization: An experimental study

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Abstract. We consider an economy 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.

1. Introduction

According to the theory of fiscal federalism, when tax revenues are needed to fund local public supply they should be decentrally collected by local authorities. However if, for instance, the benefits from local public supply spill over to other regions, a centralized tax scheme may in principle be superior to a decentralized one in order to prevent an inefficient provision of public goods (see Inman and Rubinfeld, 1997; and Oates, 1999 for recent surveys).

In deriving such normative guidelines, the theory of fiscal federalism typically assumes that taxes can be fully enforced (however, for interesting exemptions see Cremer and Gahvari, 2000; and Stöwhase and Traxler, 2004). But, in reality, the enforcement of tax compliance is costly. Moreover, it is generally agreed upon that empirically existing levels of tax enforcement are insufficient to effectively deter tax evasion (Andreoni et al., 1998).¹ The phenomenon that people continue to pay taxes in spite of strong incentives for noncompliance has been often referred to as “tax morale” (Alm et al., 1992; Frey, 1997; Torgler, 2002).

Several (predominantly empirical) studies have recently focused on behavioral motives to explain tax compliance. Among the provided explanations, two will be of special interest for our study. First, although paying taxes does not formally entitle to direct benefits, taxpayers expect to get back a fair share of what they pay. The willingness to abide by the tax law has been proved to be negatively affected by the taxpayers’ perception of a large disproportion between their tax payments and what they receive from the state (see, e.g., Kirchler, 1997; Seidl and Traub, 2001). Second, people’s decision to evade taxes depends on whether the latter are properly paid by the others: The higher the number of people who free ride on tax-financed public supply, the more reluctant taxpayers become to continue paying taxes themselves (see, e.g., Spicer and Becker, 1980; Alm et al., 1992; Kahan, 1997). These two behavioral motives relevant to tax compliance are akin to the those suggested by empirical research on voluntary contributions to public goods. Numerous public goods experiments support the idea that contribution behavior is due to reciprocal and conditionally cooperative attitudes (see, e.g., Keser and van Winden, 2000; Fischbacher et al., 2001; Croson, 2002). For this reason we view tax compliance as a problem of fiscal exchange rather than as one of legal deterrence.²

Such a perspective may shed light on the reasons why tax morale interacts with political institutions. Empirical studies from Switzerland, for instance,

reveal that political participation has a positive effect on various aspects of tax compliance (Pommerehne et al., 1994; Pommerehne and Weck-Hannemann, 1996; Feld and Frey, 2002). In view of the previous discussion, a plausible explanation for this finding could be that political participation allows taxpayers to increase the share of what they get in return for their tax payments. In a recent study, Torgler and Werner (2004) establish an empirical correlation between local fiscal autonomy and tax morale in Germany. The authors define fiscal autonomy as the ratio between a municipality's tax revenues and the GDP of its federal state. Again, high fiscal autonomy makes it more likely that the residents of a municipality get back a good deal of what they have paid in taxes. This may in turn increase tax morale.³

In this paper we test for the behavioral role of fiscal exchange by focusing on how the federal structure of the revenue system interacts with tax compliance. We hypothesize that a shift from a decentralized to a centralized tax system changes the behavioral incentives to contribute to the public good via 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.⁴ 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.

We use experimental methods to test the empirical validity of such an additional incentive problem provoked by centralization. We design an experimental economy composed of two regions. Each of them provides a public good whose benefits reach beyond local boundaries. In case of decentralization, taxes col-

lected 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.

Our experimental setting is novel in several ways. First, existing experimental studies treat the decision of tax evasion basically as a choice under risk. Here, we follow a different approach. In our experiment there is no penalty at all, i.e., the audit probability is equal to zero. In this setup we are able to define tax morale as propensity to voluntarily pay taxes in spite of an individual incentive to evade taxation. By this means we deliberately focus on social motives, and can exclude risk preferences as explanation for tax compliance.⁵ 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. These results point to a disadvantage of centralized tax structures, which has been largely ignored by the previous literature.

2. The model

Consider a society consisting of two disjoint subgroups, X and Y , with members

$i \in X = \{1, \dots, m\}$ and $j \in Y = \{m + 1, \dots, m + n\}$, 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 $l = 1, \dots, m + n$ receive an (integer) endowment E_l strictly between \underline{E} and \bar{E} , where $0 < \underline{E} \leq \bar{E}$. 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.

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”.

In *decentralization*, 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:

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

In *centralization*, 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:

$$\pi_i = E_i - \tau e_i - c_i - d_i + \alpha C + \beta_x D \quad \forall i \in X \quad (1)$$

and

$$\pi_j = E_j - \tau e_j - c_j - d_j + \beta_y C + \alpha D \quad \forall j \in Y \quad (2)$$

where $1 > \alpha > \beta_x > \beta_y > 0$ is assumed.⁶ 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 self-interested reasoning in this sense implies $C = 0$ and $D = 0$, so that $\pi_l^* = E_l$ for all $l = 1, \dots, m+n$.

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 $l = 1, \dots, m+n$. Then the individual payoffs are:

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

and

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

Thus, the total welfare is

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

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

$$\sum_{l=1}^{m+n} \pi_l^* = \sum_{l=1}^{m+n} E_l \quad (3)$$

in case of general self-interested behavior.

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 $l = 1, \dots, m+n$, the result in case of centralization would be:

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

and

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

yielding a total welfare of:

$$\sum_{l=1}^{m+n} \pi_l = \left(1 - \tau + \tau \left[(m\alpha + n\beta_y) \frac{m}{m+n} + (m\beta_x + n\alpha) \frac{n}{m+n} \right] \right) \sum_{l=1}^{m+n} E_l. \quad (4)$$

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. (4) are larger than 1 and, therefore, larger than the welfare in case of general egoistic behavior as defined by Eq. (3). 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

\bar{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.

3. 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 2. 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. Henceforth, we will refer to the order CEN-DECEN as $Order = 0$ and to the or-

der 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 .⁷ 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 $l = 1, \dots, 6$ (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 rational 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 et al. (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 .

Insert Table 1 about here

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.⁸ Here, tax morale is captured by 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, for both X - and Y -types these marginal payoffs are smaller in CEN than in DECEN. This relationship 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 substitutes in the sense that they are subject to the same free-riding incentive (comparing X_{DECEN} in column (1) with X_{DECEN} in column (2), and Y_{DECEN} in column (1) with Y_{DECEN} in column (3) reveals, indeed, that the two choices yield the same marginal payoff). If, instead, locally raised taxes are pooled and used to finance both public goods, as in CEN, taxpayers face 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. 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.⁹ 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 2, 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.

A final note on the role of spillovers in our design seems appropriate. We consider non-rival and non-excludable public goods whose benefits differ between regions, i.e., groups of experimental subjects. As a consequence, people profit from the spillovers right away in their own region. In this interpretation, the cost of spillovers is confined to the welfare loss resulting from free-riding. Additional welfare costs, in the form, for instance, of congestion effects in a service providing jurisdiction, are not considered in our design.

4. 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, 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,¹⁰ guaranteeing 5 independent observations for each order (0 vs. 1).

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_i , and the individual contributions, c_i and d_i , by the individual endowment, E_i , 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 $Order = 1$).

Insert Table 2 about here

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} indicates that X -types in sessions I to III declare on average 52.71% of 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.

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

Insert Fig. 1 about here

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. Rather, 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 existing experimental research on public goods (see Ledyard, 1995 for a comprehensive survey). The differences 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), Table 2 reveals that treatment effects are less pronounced for Y -types than for X -types. From the lower panel

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 appear less pronounced 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.¹¹ 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 finding, we compare direct contributions across subjects.¹² 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.

Insert Table 3 about here

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. Tax morale is smaller for Y -types than for X -types, although the difference is insignificant in the regression.

The interaction term $Tmt \times Type$ enables us to test whether treatment effects are more pronounced for Y -types than for X -types (as predicted by Hypothesis 2). The corresponding coefficient is positive but insignificant. F-tests reveal that the variables Tmt and $Tmt \times Type$ are jointly significant ($p = 0.037$), whereas the variables $Type$ and $Tmt \times Type$ are not ($p = 0.327$). These results reconfirm that (contrary to Hypotheses 2) types do not react differently to our treatment variation.

Regarding the dependent variables c_l and d_l , marginal 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 to the neighboring region's public good (see the corresponding coefficients of the variable $Type$).

The variable $Endow$ refers to endowment relative to maximum endowment, i.e., E_i/\bar{E} . The results show that relative income declarations are negatively

associated with high endowments. Significantly negative effects can also be found for direct contributions, implying that high endowments induce slightly less direct contributions to the public goods. These findings could be expected from our discussion in Section 2.

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.

5. Discussion of the results

In Sections 2 and 3 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 does not support Hypothesis 2. This indicates that some other motivation, different from pure self-interest, shapes individuals' behavior.

A plausible candidate for explaining behavior is fairness. Recent fairness research has shown that people are strongly concerned with income inequalities. 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 line with Fehr and Schmidt (1999), we capture the notion of fairness 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 $\Delta^{IN} = (\pi_{-i} - \pi_i) = 1$. Sim-

ilarly, the 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.

Insert Table 4 about here

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.

6. 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 more efficient than centralization 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 non-compliance 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 may 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.

In this study we focus on social motives to explain tax morale. Hence, our experimental design deliberately abstracts from formal sanctions to deter tax evasion. Of course we do not claim that formal sanctions have no effect. There may be instances where a central system helps to improve tax enforcement (e.g., Stöwhase and Traxler, 2004). In that case one would need to trade-off the positive behavioral effects of decentralization on tax morale against the negative effects arising from a change in tax enforcement.

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 prohibited to communicate with the 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 shall 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	$0.6 \times [X\text{-amount}]$ $+$ $0.3 \times [Y\text{-amount}]$
Income from the projects for Y-participant	$0.1 \times [X\text{-amount}]$ $+$ $0.6 \times [Y\text{-amount}]$

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 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 the 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.

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?

Notes

¹ 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 et al., 1992, p. 22).

² Fiscal exchange has a longstanding tradition as normative principle in public finance (see, e.g., Buchanan, 1967).

³ Of course, political participation and fiscal autonomy may explain tax morale in various ways which do not refer to fiscal exchange.

⁴ For instance, a program to reduce air pollution can help especially a particular (local) community.

⁵ Rabin and Thaler (2001) discuss some of the difficulties related to risk perception.

⁶ According to Eqs. (1) and (2), we focus on pure public goods that can be consumed by all agents without congestion effects.

⁷ To distinguish between taxes and direct contributions as two means to fund the public good(s), we have used in the instructions the expressions “taxes” for the former and “direct contributions” for the latter. The literal jargon could help participants to better understand the structure of the game. In a context similar to ours, Alm et al. (1992) have shown that the usage of the word “tax” is innocent in the sense that it has no influence on tax compliance behavior.

⁸ Deci and Ryan (1985) and Frey (1997) define tax morale as an “intrinsic motivation to pay taxes”.

⁹ 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). A necessary condition for complete crowding out is, however, that the equilibrium is interior, which is not our case.

¹⁰ 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.

¹¹ Notice that these data are not statistically independent within groups.

¹² The within-subjects statistical analysis provides the same qualitative results.

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Table 1. Partial derivatives with respect to choice variables

	(1)	(2)	(3)
	$(\partial\pi_l/\partial e_l)/\tau$	$\partial\pi_l/\partial c_l$	$\partial\pi_l/\partial d_l$
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: $\alpha = 0.6$, $\beta_x = 0.3$, $\beta_y = 0.1$, $\tau = 0.25$, $\frac{m}{m+n} = \frac{n}{m+n} = \frac{1}{2}$.

Table 2. Average of relative income declarations and direct contributions

Session (Order)	No. of Subjects (Matching Groups)	Choice Variable	DECEN			CEN		
			X	Y	All	X	Y	All
I-III (0)	66 (5)	\bar{e}	52.71	43.15	47.93	41.10	35.94	38.51
		\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
IV-VI (1)	66 (5)	\bar{e}	60.81	36.43	48.62	32.13	24.56	28.34
		\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
ALL	132 (10)	\bar{e}	56.76	39.79	48.28	36.61	30.25	33.43
		\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 3. OLS regression with robust standard errors

Independent variable	Dependent variable in period t		
	e_t	c_t	d_t
	Coefficient (robust std. error)		
Constant	0.703*** (0.054)	0.510*** (0.028)	0.166*** (0.021)
Tmt	-0.202*** (0.045)	-0.001 (0.023)	-0.006 (0.010)
$Type$	-0.170 (0.098)	-0.361*** (0.028)	0.349*** (0.034)
$Tmt \times Type$	0.107 (0.076)	0.002 (0.028)	-0.000 (0.026)
$Endow$	-0.051** (0.023)	-0.069** (0.022)	-0.073*** (0.012)
$Order$	-0.054 (0.060)	-0.035 (0.032)	-0.032 (0.035)
$Period$	-0.005*** (0.001)	-0.003*** (0.001)	-0.003** (0.001)
	$N \times t = 4224$	$N \times t = 4224$	$N \times t = 4224$
	F(6, 9) = 591.10***	F(6, 9) = 1103.31***	F(6, 9) = 1880.84***
	$R^2=0.08$	$R^2= 0.39$	$R^2=0.34$

Note: Significance levels: *** ≤ 0.01 , ** ≤ 0.05 , * ≤ 0.1 .

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	$1 + \beta_x - \alpha$

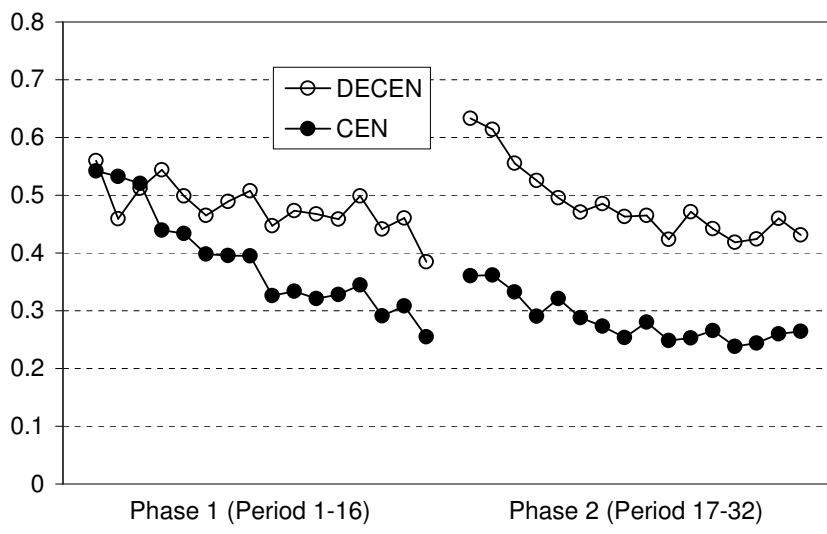


Figure 1. Average relative income declarations over periods.