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Abstract

This paper reports results from a linear sanction cost variant of the power-to-take game, with implications for tax policies. We compare a pay-as-you-earn (PAYE) system with an ex-post taxation system in which payroll taxes are collected at the end of the fiscal year. Dissatisfaction with taxation, as proxied by the sanction in the power-to-take game, is significantly higher in an ex-post taxation system compared with the PAYE system. However, in anticipation of the higher sanction, the "tax authority" will not apply lower taxes in the former system. Communication does not decrease dissatisfaction in a significant manner, and it is not used extensively by participants.

Keywords: Experiments, Tax systems, Dissatisfaction with taxes, Power-to-take game.

JEL Classification: C91; H26; D01

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1 Introduction

Taxes are as old as the State, as shown by Sumerian stone tables that refer to taxes charged in Mesopotamia in 2500 years BC.[1] Discretionary resource appropriation by authorities systematically triggers negative emotions, among which anger is the most widespread (van Winden 2007; 2015). Currently democratic governments use taxes to provide public services and goods, or pursue legitimate redistribution goals; yet people continue to dislike taxation and naturally tend to resist through actions ranging from tax avoidance to outright tax-evasion. In accordance with the early research by Schmölders (1959) and Fridland et al. (1978), a substantial body of literature has developed around the behavioral aspects of tax avoidance and tax compliance (e.g., Spicer and Becker 1980, Weigel 1987; for surveys and general perspectives on this topic, refer to Fonseca and Myles, 2011; Alm, 2012; Pickhardt and Prinz, 2014).

Tax avoidance is the observable dimension of individuals' dissatisfaction with authoritarian income confiscation. Benjamin Franklin once stated (1789) that nothing is certain "except death and taxes", a semantic tie that emphasizes the negative emotions associated with the two occurrences. A significant number of opinion polls conducted throughout the world reveal significant and ongoing discontent with taxation (Peters, 2002). In US polls, approximately 50% of the citizens declare that the amount of taxes they pay is excessively high; this figure did not vary much over a long period.[2] Kirchler (p. 119, 2007) notes that in addition to individual characteristics, negative attitudes toward taxes can be influenced by the situational and institutional context, such as the complexity of the tax code, information dissemination, involvement of taxpayers in building tax spending objectives, personal service provision by tax authorities, communication, and the design and structure of tax forms.[3]

One important institutional characteristic of the taxation system is the time sequence of the tax

[1] See www.upenn.edu/almanac/v48/n28/AncientTaxes.html

[2] See for *Gallup* historical survey data 1956-2015 : www.gallup.com/ poll/182423 /perceptions-tax-fairness-diverging-income.aspx. See also the survey by the *Pew Research Center*, showing similar levels of dissatisfaction with taxation, and also with the tax system, in "5 Facts on how Americans view Taxes" www.pewresearch.org/ fact-tank/2015/04/10/5-facts-on-how-americans-view-taxes/

[3] See, among many others, studies by Lamberton et al. 2014, Hallsworth et al. 2014, Alm et al. 2009, Alm et al. 2010, Abeler and Jager 2013, John et al. 2011, Shu et al. 2012.

collection process. The large majority of Western countries run a system of taxes that are withheld at the source of income. Applied to the labor income tax, the “pay-as-you-earn” (PAYE) tax is withheld from an employee’s wages by their employer who directly sends the withheld amount to the appropriate taxing authority. In this system, employees receive the tax and net income information at the same time. In the alternative "ex-post taxation" system, the payroll tax is paid by the employee from his/her own revenue, normally at the end of the year. Thus, the employee will first receive the gross income information and, with a lag, will learn the tax and the net income. Among developed countries, only France, Switzerland and Singapore continue to use the latter, with France expected to move to the PAYE system in 2018 at the latest. The costs of collecting one currency unit of taxes are no higher in the ex-post system compared to the PAYE system; thus, this important feature cannot explain the prevalence of the latter in the developed world.

Can behavioral analysis provide a plausible alternative explanation? According to the aspiration-level theory, happiness is determined by the gap between an individual’s aspiration and achievement (Michalos, 1991, Inglehart, 1990, Frey and Stutzer, 2002). In the tax context, dissatisfaction should be higher if taxes exceed what agents consider to be "normal", and vice-versa. Most individuals try to put a higher weights on the most recent information. Thus, in the PAYE system, individuals’ experience-based beliefs of what the normal tax rate is will be instantaneously adjusted by taking into account the observed tax rate. In the ex-post system, individuals will confront the actual tax to an established reference, based on the past values. If, in line with the above mentioned opinion polls, human beings systematically underestimate the "normal tax burden", then dissatisfaction should by higher in the ex-post system compared to the PAYE system. This utility loss relative to different reference points would be further amplified by the loss aversion mechanism, where a loss, identical in absolute value to a gain does entail a higher variation in utility, according to the classical result by Kahneman and Tversky (1979) and Tversky and Kahneman (1991). Finally, income taxes are more salient in the ex-post system compared to the PAYE system, in which taxpayers focus on the net income. As shown by Chetty et al. (2009) in a different setting, when individuals perceive the tax more prominently, they are also more dissatisfied.[4]

This paper' main objective is to report new experimental evidence on whether individual dissatisfaction with taxation depends on the moment when taxes are levied. To compare dissatisfaction with taxation in the two systems, we develop a variant of the "power-to-take" game introduced by Bosman and van Winden (2002). In the original game, there are two players, the "taker" and the "responder". At the outset of the experiment, the responder receives an endowment. Then, the taker decides on the take rate (a tax rate), to be applied to the responder's endowment. In the second stage, the responder chooses a "destroy rate" that will reduce the payoffs of both agents. The destroy rate is usually interpreted as a measure of the responder's dissatisfaction with taxation. As mentioned by van Winden (2015), on average, takers claim about 60% of the responder's resources while responders destroy about 20%. However, as noted by Galeotti (2015), in this game the fine-to-tax rate is decreasing in the tax rate; thus, it may be tempting to punish when the tax rate is high only because it is relatively cheaper to punish. To eliminate this "demand for punishment" effect, in this paper we introduce a power-to-take game with a linear punishing cost. This linear punishment technology, involving a constant cost per unit of punishment, has been used in many other studies (inter alia, Fehr and Gachter, 2000; Falk and Fischbacher, 2005; Nikiforakis and Normann, 2008). We will avoid using labels such as "taxpayer" and "tax authority"; however, of course, the design targets replication of the taxation context. There is an Agent A who receives an endowment (implicitly, our "taxpayer") and an Agent B (implicitly, the "tax authority") who can take some of the Agent's A endowment (this "tax" being an earning for Agent B himself). In the second stage, Agent A can impose a sanction on Agent B. The sanction will reduce the payoff of Agent B; furthermore, imposing a sanction entails a cost to Agent A that is proportional to the sanction. When possible, agents will be provided the opportunity to reveal their guess regarding the subsequent decision of their partner. These guesses are cash-incentivized. The analysis will focus on factors that explain the sanction, viewed as a measure of taxpayers' discontent with taxation.

[4] Chetty et al. (2009) show that consumers react by reducing demand if posted prices include the VAT, compared to prices quoting the VAT separately.

We acknowledge that pre-tax communication may help reduce dissatisfaction, if the tax administration manages to convince taxpayers of the usefulness or moral justification of the tax (Hallsworth et al., 2014), or merely by sending convincing apologies (Fischbacher and Utikal, 2013). Hence, to analyze whether communication has an impact on the sanction, we also implement sessions in which Agent B (the tax authority) can send a short message to Agent A. All things being equal, we conjecture that positive communication should help in accepting a higher tax; thus, if allowed, participants should have all incentives to provide positive signals.

In the last treatment, the amount of the tax (and income for Agent B) is randomly determined by the computer. Thus, Agent B no longer bears the responsibility for the diminished endowment of Agent A. We would expect the sanction to be much lower in this case compared with cases in which Agent B decides on the tax.

Experimentalists are always very cautious when trying to extrapolate conclusions from Lab experiments to real-life situations, and this paper makes no exception to the rule. Without providing details, our analysis reveals that sanctions in the PAYE system are significantly lower than in the ex-post system, even when controlling for the amount of taxes. Participants in the role of the tax authority do not exploit the full potential of the message, and the impact of these messages on the sanction is weak. Although smaller, sanctions are at positive significant levels in the last treatment in which the amount of the tax was determined by the computer.

It must be acknowledged that our design does not allow to take into account two important characteristics of real-life tax systems. First, the experiment focuses on the confiscatory dimension of taxation, without considering the "purpose" dimension, or the personal or social benefit individuals associate to the act of paying taxes. Second, the act of paying taxes has a social dimension, where an individual's attitude toward taxes depends on the attitude of the other people in a similar tax-payer role, and with whom the individual interacts (Onu and Oats, 2015; van Winden, 2015). While our design allows for strategic interaction between the taxpayer and the tax authorities, the relationship between the individual and the group of taxpayers has not been taken into account. Further research might include these additional layers in the analysis.

This paper is organized as follows. The next section introduces the experimental design.

Section 3 presents the basic statistics and then the regression analyses. The last section presents the concluding remarks and the policy implications.

2 Design of the experiment

Experimental sessions were performed at the LESSAC Experimental Lab; all subjects were recruited from the student population of the ESC Dijon Business School (France), who answered an advertisement for paid decision experiments. The experimental sessions were organized in October 2015. Interaction was strictly anonymous. Participants played the game on a computer screen and could not establish eye contact with one another. The data collection was computerized; the program was developed using z-Tree (Fischbacher 2007).

At the beginning of the experiment, participants were assigned a role, Agent A or Agent B, which will not change thereafter; they were not told that the roles will not change. In an attempt to collect more data, participants were requested to play the same game for three identical rounds; nonetheless, pairs were rematched after each round (stranger design), and participants knew it.

The compensation was provided in cash at the end of the session. Compensation included a 50 ECUs show-up fee and the gain of one of the three rounds chosen at random. The exchange rate is 5 ECUs=1€. On average, participants earned 8 euros per session for 35 minutes of presence in the Lab.

We run four key treatments with a 2x2 structure, varying the time of applying the tax and the possibility to send a message (Figure 1). A fifth treatment, in which the computer decided the amount to be transferred from Agent A to Agent B, targets providing additional insights. Students participating to one treatment could not participate to another treatment, in a standard between-subjects design. We introduce here the key steps of the experiment, as outlined in the Introduction (detailed instructions are available in the Appendix).

Treatment 1 (T1) - the "ex-post" tax system

Step 1. At the beginning of each round, the computer draws at random an ECU denominated endowment as an integer Y in the set $[50, 100]$ (the trial has a uniform distribution).

Step 2. Agent A receives this amount. He is invited to make a guess $G[T]$ regarding the amount

T that Agent B will take from him at the next step. For his guess, he will receive a compensation determined by the formula $20/[1 + (T - G[T])^2]$. The payoff is an increasing function in the precision of the guess, with a maximum of 20 ECUs.[5]

Step 3. It is the turn of Agent B to decide. He can take T from Agent A, with $T \in [0, Y]$. however, before applying the tax, he must make a guess $G[S]$ regarding the sanction S that Agent B will impose on him. This guess is incentivized, he will receive a payoff $20/[1 + (S - G[S])^2]$. After the guess, he decides on tax T.

Step 4.In this last move Agent A can impose a sanction S on Agent B, with $S \in [0, T]$. Each ECU of the sanction will cost Agent A the 0.2 ECUs.

As previously noted, these steps are repeated for three identical rounds. After each round, the two players learn their gain for that round. The gain of Agent B is $(T - S)$, to which will be added the payoff for the guess of the sanction. The final gain of Agent A is $(Y - T - 0.2S)$, to which will be added the payoff for his guess of the tax.

Treatment 2. (T2) - the PAYE system

Treatment 2 is nearly similar to Treatment 1, with the notable difference that, once that the computer has drawn the endowment Y, Agent B learns this amount and can immediately tax T. Thus Agent A simultaneously observes Y, T, and $(Y - T)$. He no longer has the time and opportunity to make a guess on what would be the tax, because the tax has already been levied. The decision steps are:

Step 1. As before, at the beginning of each round, the computer draws an integer Y from the set $[50, 100]$ according to a uniform distribution. Denominated in ECUs, it will provide the essential of the income of Agent A.

Step 2. Agent B learns this amount, and can levy a tax $T \in [0, Y]$. Before he must make a guess $G[S]$ regarding the sanction S that Agent A will impose on him at the end of the round. This guess is also incentivized; he will receive an additional payoff $20/[1 + (S - G[S])^2]$.

Step 3. Agent A learns Y, T and his endowment $[Y - T]$. He can impose a sanction S on

[5] We avoid the standard notation $E[x]$, to acknowledge that a "guess" is not necessarily the mathematical expectation of the variable x.

	Ex-post tax	**PAYE tax**
Human - no message	T1 (60 Subjects)	T2 (72 Subjects)
Human - with message	T3 (72 Subjects)	T4 (72 Subjects)
Computer - no message	—	T5 (26 Subjects)

Table 1: Plan of experiements

Agent B, with $S \in [0, T]$. Each ECU of the sanction will cost Agent A 0.2 ECUs.

After each of the three rounds, players learn their gain for the round. For each round, the gain of Agent B is $(T - S)$ plus the guess payoff, and the final gain of Agent A is $(Y - T - 0.2S)$.

Treatment 3 (T3) is similar to Treatment 1 (Ex-post) except that now Agent B can send a maximum 80-character message to player A "related to his decisions in the game". Player A views the message at the same time he learns the tax and before he decides on the sanction. We purposefully choose to let the content of the message be free, to obtain a subtler understanding on how subjects understand the problem. In other experiments, players can choose from a list of pre-formatted messages (refs).

Treatment 4 (T4) is similar to Treatment 2 (PAYE), with the same message possibilities.

Treatment 5 (T5) is a variant of Treatment 2, except that this time the computer will determine at random the amount T to be transferred from Agent A to Agent B. Agent A knows that the amount was determined by the computer; he can still impose a sanction S on Agent B. This treatment is useful because it allows us to analyze sanctioning behavior when Agent B does not bear the "responsibility" for taxing.

3 Results

3.1 Basic statistics

Table 3 presents simple descriptive statistics for the five treatments. The endowment Y was generated by uniform random sampling in the interval $[50; 100]$; therefore, the mean of the endowment ($\bar{Y} = 75$ECUs) does not differ across the groups. As previously noted, the amount taken (the tax) is denoted by T, and the sanction is denoted by S. The guesses regarding the tax and the sanction are denoted by $G[T]$ and $G[S]$ respectively. We also calculate the tax rate T/Y and the sanction rate S/Y, as well as the guess rates for the tax and the sanction.

Type	Frequency	Example
Apologies	6.6%	*Sorry; I apologize*
Call for coordination, fairness, moral	47.9%	*I took 50%, this is not much; Punishing is bad*
Creating sympathy	26.4%	*Hello; smiley*
Aggressive/Ironic	14.1%	*Too bad for you, I took everything*
Meaningless	5.0%	*Azerty;*
TOTAL	100%	

Table 2: Typology of Messages

In treatments T2 and T4, Agents B can send messages to Agents A; they sent messages in 56% of the cases. Thus, we create an indicator variable DI that takes the value 1 if the subject has actually sent a message and 0 if not. Specifically, these messages can be grouped into five categories:

Certainly, the last two rows are puzzling; however, this is the charm of experimental work, to obtain deeper information regarding human nature.

Thus, in Table 3, the second column "Treatment 3 (or 4) [all]" presents statistics for the entire sample, the last column [DI=1] presents statistics only for cases in which Agent B has sent a message.

Since Y is drawn from a relatively narrow range of income, variations in Y should not generate a substantial wealth effect. Therefore, to facilitate comparisons, we prefer to base our analysis on relative numbers, focusing on the ratios between $T, S, G[T]$ and $G[S]$ to the income Y.

On average, t**ax rates** (T/Y) are higher in T1 compared with T2 [F=8,93, p<0.01], however, the difference between T3 and T4 narrows to non-significant levels [F=1,53,p=0.22] (Figure 1). In other words, tax rates are higher in the ex-post system as compared to the PAYE system solely when communication is not allowed.

On average, **sanction rates** (S/Y) – our proxy for dissatisfaction with taxes – differ from one treatment to another, as represented in Figure 2, which reveals important behavioral differences.

First, sanction rates are much higher in the Ex-post system compared with the PAYE system, regardless whether messages are allowed (without message 0.40>0.17; [F=1905; p<0.001]; with message 0.27>0.15; [F=5.81; p=0.019]).

Second, within the PAYE system, sanction rates are lower when messages are allowed than

	Treatment 1			Treatment 3 [all]			Treatment 3 [DI=1]		
	Nb.Obs	Mean	Sdev	Nb.Obs	Mean	Sdev	Nb.Obs	Mean	Sdev
Y	90	74.22	13.87	108	74.39	14.50	55	74.82	14.74
T	90	50.73	24.28	108	46.02	21.47	55	45.35	20.12
S	90	29.08	28.74	108	19.00	23.58	55	20.13	24.16
$G[T]$	90	50.64	21.34	108	45.86	18.90	55	45.75	20.74
$G[S]$	90	37.36	27.80	108	27.22	27.10	55	26.02	27.45
T/Y	90	0.68	0.30	108	0.62	0.27	55	0.62	0.26
S/Y	90	0.40	0.38	108	0.27	0.33	55	0.28	0.35
S/T	89	0.52	0.42	107	0.37	0.39	54	0.38	0.41
$G[T]/Y$	90	0.68	0.26	108	0.61	0.22	55	0.60	0.23
$G[S]/Y$	90	0.50	0.35	108	0.36	0.35	55	0.34	0.35
	Treatment 2			**Treatment 4 [all]**			**Treatment 4 [DI=1]**		
	Nb.Obs	Mean	Sdev	Nb.obs	Mean	Sdev	Nb.Obs	Mean	Sdev
Y	108	75.63	14.36	108	75.65	14.33	66	75.00	13.71
T	108	40.88	22.59	108	43.01	21.10	66	40.95	19.38
S	108	12.94	20.47	108	11.87	23.43	66	10.97	21.00
$G[S]$	108	13.69	19.83	108	15.56	19.93	66	15.35	21.23
T/Y	108	0.53	0.27	108	0.57	0.26	66	0.55	0.24
S/Y	108	0.17	0.26	108	0.15	0.29	66	0.15	0.28
S/T	103	0.30	0.37	104	0.22	0.36	63	0.23	0.35
$G[S]/Y$	108	0.18	0.24	108	0.21	0.27	66	0.21	0.29
	Treatment 5								
	Nb. Obs	Mean	Sdev						
Y	81	72.94	13.65						
T	81	37.17	21.83						
S	81	7.99	13.68						
T/Y	81	0.51	0.29						
S/Y	81	0.11	0.20						
S/T	81	0.25	0.38						

Table 3: Basic Statistics

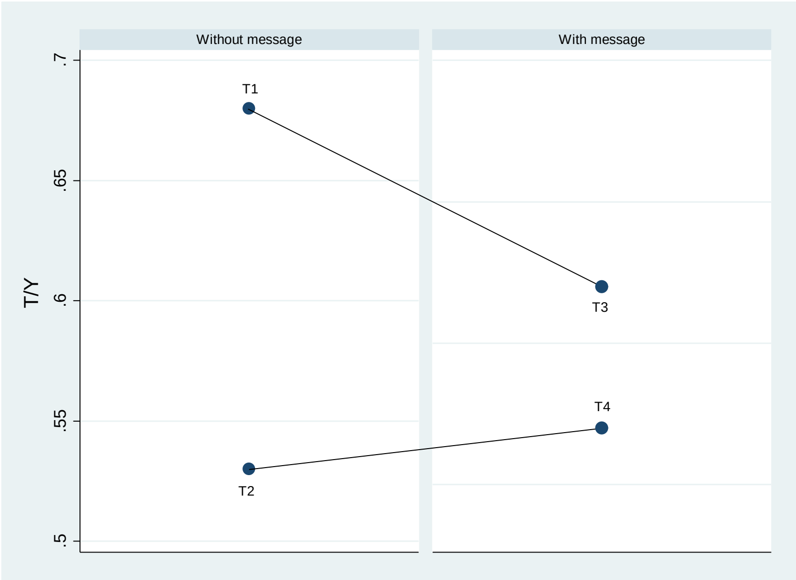


Figure 1: Average tax rates (T/Y) in the ex-post and PAYE framework, without and with message

without messages (0.40>0.27) [F=4.87, p=0,031]. In the ex-post tax system, messages have negligible impact on sanctions.

On average, the guessed tax rate is very close to the actual tax rate in both T1 and T2 (0.68 vs. 0.68 and 0.60 vs. 0.62). In general, individuals tend to overestimate the sanction; the average guessed sanction rate is higher than the average actual sanction rate regardless the treatment. However, as shown by "actual vs. guess" scatter diagrams in Figures 3 and 4, there are substantial discrepancies between actual and guessed values across individuals and rounds.[6]

[6] To get a better understanding of the relationship between the actual values of T and S and the related guesses, we run several regressions with the variance between the actual and guessed values as a dependent variable, and having as covariates round and treatment dummies. We could not detect any learning effect, neither in the tax guess, nor in the sanction guess. The treatment dummies are not significant either.

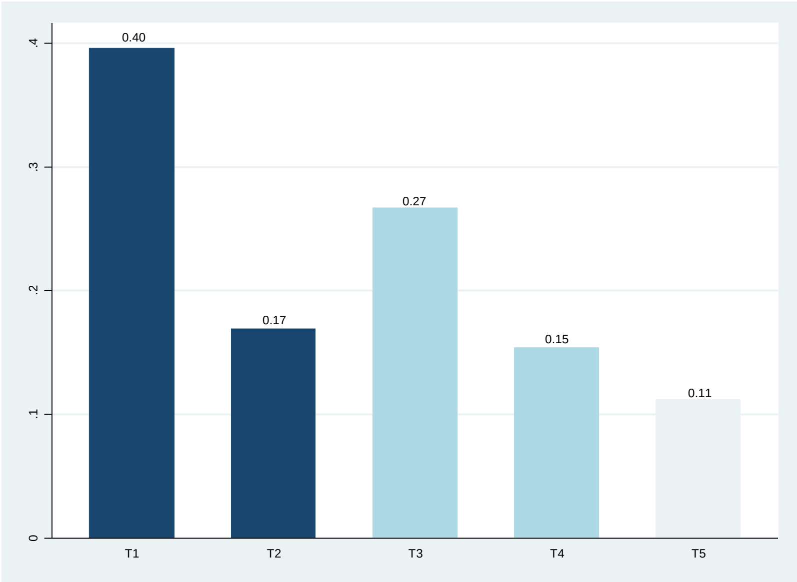
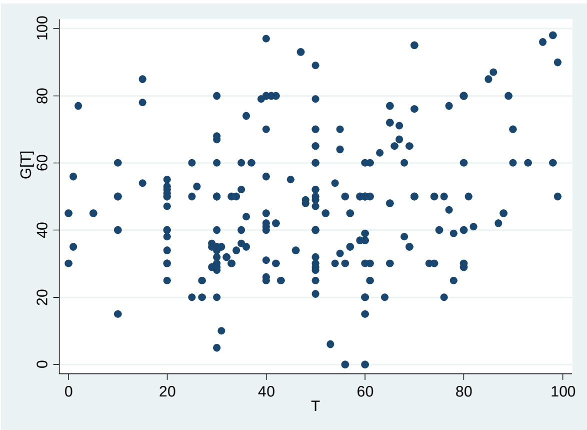


Figure 2: Average sanction rates (S/Y)



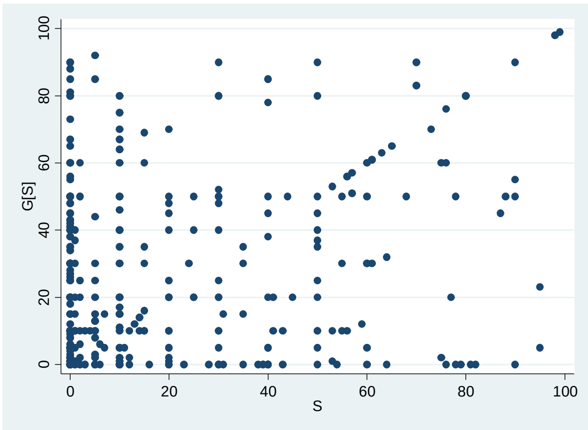


Figure 3. Actual and guessed tax

Figure 4. Actual and guessed sanction

The last treatment, T5, is a variant of treatment T2 with the important difference that the computer decided on the amount of ECUs to be transferred from Agent A to Agent B (a human subject). In this context, Agent B cannot be held responsible for the tax, although the tax ultimately becomes his income. Hence, if Agent A imposes a sanction, the latter cannot be driven by "retaliation". Such a sanction would be a plain measure of frustration for having his income reduced. The difference in average sanction rates (S/Y) between T5 and T2 is not statistically significant [F=2,365, p=0,129]. Furthermore, because in T5 the Computer drew on average a lower tax compared to the other treatments, we also compare the ratio S/T, which is the proportion of the sanction with respect to the tax. In T5, this sanction rate is large at 25% of the tax, which is close to the 30% recorded in T2 [F=0,744,p=0,392]. This finding suggests that sanctions are essentially driven by negative emotions related to the income reduction, independent of the responsibility of the tax-authority and the retaliation/vengeance motive. That negative emotions are an important motive for punishment in the power-to-take game has already been emphasized by Galeotti (2015).

3.2 Regression analysis

Regression analysis allows us to move beyond the insights provided by the descriptive statistics. We study first the behavior of the "tax authority", then turn to the key point of the analysis, the sanctioning behavior of the "taxpayer". In order to carry out our regression analyses, we create two indicator variables. The "system indicator variable" DT takes the value 1 in treatments in which the tax is levied *after* Agent A has learned the income and made a guess about the tax ("ex-post system"), and takes the value 0 in the PAYE system. Thus $DT = 1$ if treatment $=\{$T1, T3$\}$ and $DT = 0$ if treatment=$\{$T2,T4$\}$. The "message indicator variable" DM has already been defined; it takes the value 1 in treatments in which messages are allowed. Thus $DM = 1$ if treatment=$\{$T3,T4$\}$ and $DM = 0$ if treatment=$\{$T1,T2$\}$. An alternative variable that strives to capture the impact of the message is the indicator variable DI which takes the value 1 if an individual has actually sent a message in T2 and T4, and zero if else. In the no-message treatments (T1 and T3), by default $DI = 0$. We also developed round dummies, R_1 and R_2 (R_3 being the reference).

a/ Behavior of Agent B [the "Tax authority"]

The behavior of the "tax authority" [Agent B] can be analyzed by means of a "Tax equation", which relates the individual tax rate $TR = T/Y$ to the indicator variables. In some regressions we also use as a covariate the guess of the sanction rate $GSR = G[S]/Y$. In certain regressions, we also included an interaction term $DT \times DM$ (or $DT \times DI$); however, because this term was

	Model 1	Model 2	Model 3	Model 4
DT	0.100***	0.099***	0.042	0.042
DM	-0.001	–	-0.003	–
DI	–	-0.024	–	-0.012
GSR	–	–	0.248***	0.247***
R_1	-0.106***	-0.106***	-0.098***	-0.097***
R_2	-0.034	-0.035	-0.036	-0.036
Ct	0.603***	0.606***	0.546***	0.551***
Nb obs.	414	414	414	414
R-sq	0.06	0.06	0.14	0.14

(Legend: *** significant at 1%)

Table 4: The Tax Equation

not statistical significant, we do not present them here.

Table 4 presents the output of the regression models, with the tax rate TR as a dependent variable. Because subjects took three successive decisions (with different partners), we use a standard Random Effect (RE) panel regression model to control for the individual specific effect.

Result 1. *The tax rate is higher by 10 percentage points in the ex-post system as compared to the PAYE system, with the possibility to send a message having a negligible impact on it.*

In both Model 1 and Model 2, the coefficient of the DT indicator is statistically and economically significant, while the coefficients of DM and respectively DI are small and not significant.

The descriptive statistics (Figure 1) have pointed out to the same gap in tax rates between the ex-post and the PAYE system, but also suggested that the difference would shrink when tax authorities can send messages, a result that is not corroborated by the regression analysis.

Result 2. *The higher tax in the ex-post system is essentially driven by anticipations of higher sanctions.*

When the regression model include the guessed sanction (in Model 3 and Model 4), the significance of the system indicator variable vanishes, while the coefficient on the guess variable is highly significant. This finding suggests that, in this experiment, the tax-authority is prompted to tax more to offset the higher sanction specific to ex-post treatments. While it is very risky to extrapolate this finding to real life situations, this result would suggest some "vicious circle" at work in ex-post tax systems, where tax authorities tax more just to offset the higher discontent with taxation, and discontent is high because of the high tax rates, inter alia.

	Model 1	Model 2	Model 3	Model 4
DT	0.104***	0.100***	n.a.	n.a.
DM	-0.063*	–	-0.110**	–
DI	–	-0.025	–	-0.061
TR	0.632***	0.633***	0.700***	0.708***
GTR			-0.325***	-0.318***
R_1	-0.007	-0.007	-0.054	-0.049
R_2	-0.002	-0.003	-0.042	-0.043
Ct	-0.152***	-0.176***	0.173*	0.117
Nb obs.	414	414	198	198
R-sq	0.34	0.34	0.38	0.35

(Legend: *** significant at 1%; ** significant at 5%; * significant at 10%)

Table 5: The Sanction Equation

Finally, it can be noticed that tax rates increase over the three rounds, with a tax rate in R_1 significantly lower than in R_3.[7] The declining cooperation over time is surprising in a design that allows for punishment of the "greedy" tax-authority.

b/ Behavior of Agent A [the "Taxpayer"]

In this experiment we allowed the taxed agent to impose a fine on the taxing agent. Because the sanction involves a cost for the "punisher", it can be interpreted as a measure of the dissatisfaction of the latter with the tax. The analysis of the treatment 5 has revealed that sanctions are mainly driven by negative emotions, because they are applied even when Agent B is not responsible for the income confiscation. Table 5 presents the results of RE regression models with the individual sanction rate $SR = T/Y$ as the dependent variable. In addition to indicator variables defined previously, the other covariates are the tax rate $TR = T/Y$ and the guessed tax rate $GTR = G[T]/Y$.

As expected, the sanction rate increases with the tax rate, as shown by the positive and statistical significant coefficient of TR. Models 1 and 2 would suggest that all things equal, raising the tax rate by 10 percentage points would increase the sanction rate by 6.3 percentage points.

Result 3. *The sanction rate is significantly higher in the ex-post tax system as compared to the PAYE system.*

The coefficient of DT indicates that the sanction rate is on average higher by 10 percentage

[7] Because this round effect is present, it is important to control for it.

points in the ex-post tax system as compared to the PAYE system. This finding is in line with the descriptive statistics (Figure 2) where on average the sanction rate is higher in T1 compared with T2, and higher in T3 compared with T4.

Result 4. *Sanctions tend to be weaker in treatments with messages as compared with treatments without messages.*

As shown by the (weak) statistically significant coefficient on DM. The descriptive statistics revealed such a difference in the ex-post context (T1 compared with T3), but not in the PAYE context (T2 compared to T4). We checked whether different response to messages is revealed by the regression analysis, but the interaction term $DTxDI$ was not statistical significant.

Furthermore, if we use the alternative DI indicator variable (in Model 2 and Model 4) instead of DM, to compare cases where messages have actually been sent with all other cases, messages themselves do not contribute to reduce the sanction. To ensure that the impact of the aggressive/ironic messages (14.1% of total messages) does not offset the impact of positive messages, we split the DI variable into DI_N (negative) and DI_P (positive), and run Model 2 again. Signs of the estimated coefficients point into the appropriate direction (negative message tend to foster dissatisfaction, and vice-versa); however, the coefficients are not statistically significant.

Models 3 and 4 were estimated only for treatments T1 and T3 in which we collected information regarding the guessed tax, allow us to provide additional insights. The output table indicates that, all things being equal, the sanction rate is positively related to the actual tax rate and negatively related to the expected tax rate. The latter effect reveals a standard aspiration-based mechanism. Focusing on the effects of these two variables, the sanction equation can be written as:

$$SR = C + 0.70TR - 0.32G[TR] + other,$$

or, alternatively, as:

$$SR = C + 0.38TR - 0.32\,(G[TR] - TR) + other.$$

In this equivalent expression, the sanction rate depends on the tax rate, and on the gap between the actual and the guessed tax. As long as the actual tax rate is below the expected tax rate, the sanction rate is marginally reduced by 1 percentage point for every 3 percentage point gap and vice-versa, if the tax rate is above the expected value, the sanction rate is marginally increased by 1 percentage point for every 3 percentage point gap.

Result 5. *If the tax rate is above (below) the expected tax, the sanction rate is higher (lower).*

This results corroborate something policymakers throughout the world know well: deceiving tax expectations is a politically dangerous move. Promising low taxes and then unfulfilling these promises have turned down more than one government.

Contrary to the tax rate, the sanction rate is not subject to a round effect.

4 Conclusion

This paper reports results from a linear sanction variant of the power-to-take game (Bosman and van Winden, 2002) with implications for taxation policies. In this experiment, in the last stage of the game, the taxpayer (Agent A) can impose a sanction on the tax authority (Agent B). Because the sanction costs something to the punisher, it can be viewed as a measure of his dissatisfaction with the action of Agent B. Data show that the PAYE system, in which taxes are levied before the taxpayer can form beliefs regarding the amount of the tax, generates lower dissatisfaction with taxation than the ex-post system. Despite the higher dissatisfaction with taxes in the ex-post system, the tax rate is at least as high as in the PAYE system. It appears that the ex-post system creates a more non-cooperative environment, in which the tax authority raises taxes to offset the incoming sanction. In general, subjects expect higher sanctions than the true amount they will receive in the end.

It is surprising to observe that a non-negligible number of participants playing the tax authority role did not use the communication tool to send justification messages or merely to apologize. These participants' choice appears to be validated by the weak response of "taxpayers" to such messages. In the specific case of this experiment, this result may be related to the youth of the participants. It would be interesting for further research to run the experiment with subjects who have more significant work experience.

Last, the comparison of sanction rates when the tax-authority is played by a human subject and when the tax decision is made by the computer reveals that dissatisfaction with taxes is independent of the responsibility of the taxing authority to tax. Indeed, on average participants in the role of taxpayers (Agents A) sanctioned Agents B as much as 25% of the tax when the computer determined the amount they will receive.

There is no need to stress that these results should be interpreted with extreme caution when transposed to policy recommendations. The lower discontent with taxation in the PAYE system compared with the ex-post system may explain the prevalence of the former system in the Western world, and backs the decision of France to move from the ex-post tax system to the PAYE system by 2018. This conclusion reflects the perspective governments interested in taxing at the lowest political cost. If a small government is to be preferred to a large one, the ex-post tax system may create better incentive for reducing taxes and ultimately, the size of the State.

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5 Appendix. Instructions

We provide here the instructions for T3 and T4; T1 and T2 are similar, without the dialogue box. T5 is similar to T2, but the amount of the transfer from Agent A to Agent B is determined at random by the Computer.

5.1 Treatement T3

Slide 1. Introduction

Good morning.

Thank you for participating to this experiment.

Please read carefully these instructions, and should you have any question, please raise your hand and the administrator will join you so that you can ask him/her the question.

Cellular phones must be turned off. Please do not try to communicate between you. If such a thing happens you will be asked to leave the room.

Your compensation for your participation will be provided in cash at the end of the session.

Payoffs in the experiment are denominated in Experimental Currency Units (ECU).

At the outset of the game each subject receives 50 ECUs a show up fee. The additional compensation depends on his/her performance in the experiment. The session involves three identical round. At the end of the gain, the computer will draw at random one of the round, and the ECU payoff will be paid to you in cash.

The exchange rate is 10 ECU = 1 euro.

Slide 2. The description of the experiment

You will play the same game three times. Each time, you will be paired with another player, chosen at random in the population of students present in the room. Pairs will change from one round to another. Anonymity is strictly guaranteed.

Each pair includes a Player A and a Player B

1st step. At the beginning of each round the computer draws an integer Y in the interval $[50, 100]$.

2nd step. Agent A is informed that he received this endowment

3rd step. Agent B learns the amount Y received by agent A and can take an amount T in the interval $[0, Y]$.

4th step. Agent A learns the amount T taken by agent B and can impose a fine S on agent B. The fine can vary between $[0, T]$.For each 1 ECU of fine, the Agent A will bear a loss of 0.2 ECUs.

Thus, at the end of the round, the payoff of Agent A is $(Y - T - 0.2S)$, where T is chosen by Agent B and S is chosen by Agent A. The payoff of Agent B is $(T - S)$, where S is the sanction decided by Agent A.

Slide 3A. "You are Agent A"

Following the Computer draw in the interval $[50, 100]$ you get the endowment $Y = ...$ECUs.

At the next stage, Agent B can take an amount T in the interval $[0, Y]$.

You will be allowed to impose on him a fine S in the interval $[0, T]$. This sanction will reduce the payoff of Agent B. Your own payoff will be reduced by 0.2 ECU for each 1 ECU of fine.

- What is your guess about the amount T that Agent B will take from you ? Fill in this box [......]

You will be rewarded for this guess according to the function $G = 20/[1 + (T - E)^2]$,where E is your guess of T. This expression means that you will win the most (20 ECUS) if the guess is equal to the actual amount.

Slide 3B. "You are Agent B".

Following the Computer draw in the interval $[50, 100]$,Agent A received the amount $Y = ...$ECUs.

You can take an amount T in the interval $[0, Y]$,after having answered to an intermediary question.

Following your decision, Agent A will be able to impose on you a fine S in the interval $[0, T]$. Each 1ECU of fine will cost him/her 0.2 ECUs.

- What is your guess about the sanction S that Agent A will impose on you ? Fill in this box [...]

You will be rewarded for this guess according to the function $G = 20/[1 + (S - Z)^2]$,where Z is your guess of S. This expression means that you will win the most (20 ECUS) if the guess is equal to the actual amount.

- What is the amount you want to take from Agent A ? Fill in this box [...]

=====================

- You can send a max 80 characters message to Agent A. Fill in this box [...........................][8]

=====================

Slide 4. You are Agent A

Following the random draw of the Computer you got $Y = $ ...ECUs

Agent B has taken the amount $T = $ ...

You thus will get the difference $D = $ ...

He/she sends you this message [...... e.g. "hello"............]

You can impose on him/her a fine S, in the interval $[0..T]$. This fine will reduce the amount available for Agent B and will cost you 0.2 ECU per each ECU charged.

What is the amount of the fine S you want to charge ? Fill in this box [...]

Slide 5A. Payoffs. You are Agent A

You received $Y = $ ...

Agent B took $T = $ ...

Your guess of T was E=...

You required a fine $S = $ ...

Your final gain for this round is ...

Slide 5B. Payoffs. You are Agent B

Agent A received $Y = $ ...

You took $T = $ ...

Your guess of S was $Z = $...

The fine you received was $S = $ ...

Your final gain for this round is...

[8] The message box is not available in treatments T1, T2 and T5.

5.2 Treatment 4

Slide 1. Introduction

Identical T3

Slide 2. The description of the experiment

You will play the same game three times. Each time, you will be paired with another player, chosen at random in the population of students present in the room. Pairs will change from one round to another. Anonymity is strictly guaranteed.

Each pair includes a Player A and a Player B

1st step. At the beginning of each round the computer draws an integer Y in the interval $[50, 100]$.

2nd step. Agent B learns this amount and can take an amount T in the interval $[0, Y]$. He knows that the difference will go to Agent A.

3rd step. Agent A is informed about Y and about T. He thus receives the difference $(Y - T)$.

4th step. Agent A can impose a fine S on agent B. The fine can vary between $[0, T]$.For each 1 ECU of fine, the Agent A will bear a loss of 0.2 ECUs.

Thus, at the end of the round, the payoff of Agent A is $(Y - T - 0.2S)$, where T is chosen by Agent B and S is chosen by Agent A. The payoff of Agent B is $(T - S)$, where S is the sanction decided by Agent A.

Slide 3. "You are Agent B".

The Computer drew in the interval $[50, 100]$ the amount $Y =$ ...ECUs.

You can take an amount T in the interval $[0, Y]$,after having answered to an intermediary question. The difference $[Y - T]$ will be given to Agent A.

Agent A will be informed about Y and T. He will be able to impose on you a fine S in the interval $[0, T]$. The fine will reduce you own payoff. Each 1ECU of fine will cost 0.2ECU to Agent A.

- What is your guess about the sanction S that Agent A will impose on you ? Fill in this box [...]

You will be rewarded for this guess according to the function $G = 20/[1 + (S - Z)^2]$,where Z is your guess of S. This expression means that you will win the most (20 ECUS) if the guess is equal to the actual amount.

- What is the amount you want to take from Agent A ? Fill in this box [...]

=====================

- You can send a max 80 character message to Agent A. Fill in this box [..........e.g. "hello"................]

=====================

Slide 4. You are Agent A

The Computer drew $Y =$ ...ECUs

Agent B has taken the amount $T =$ ...

Your receive the difference $(Y - T) =$ ...

He/she sends you this message [......... e.g. "hello"...........]

=====================

You can impose on him/her a fine S, in the interval $[0..T]$. This fine will reduce the amount available for Agent B and will cost you 0.2 ECU per ECU charged.

What is the amount of the fine S you want to charge ? Fill in this box [...]

Slide 5A. Payoffs. You are Agent A

The Computer drew $Y =$ ...

Agent B took $T =$ ...

You imposed on Agent B a fine $S =$ ...

Your final gain for this round is ...

Slide 5B. Payoffs. You are Agent B

The Computer drew $Y =$ ...

You took $T =$ ...

Your guess of S was Z=...

The fine your received was $S =$ ...

Your final gain for this round is....

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