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Labour supply in presence of taxation financing public services. An experimental approach

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Labour Supply in Presence of Taxation Financing Public Services. An Experimental Approach.

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Abstract: The paper illustrates the results of some experiments aiming to test the effect of taxation on the effort. Differently from previous experiments (Levy-Garboua et al., Sutter and Weck-Hannemann, Swenson), in our research the revenue of taxation is not depleted but employed, more realistically, to finance welfare provisions. The result is no more a reduction of effort, as in previous experiments, but a slight increase. This behavior is coherent with a theoretical model suggested by Bird in 2001.

JEL classification: D31, H23, H53

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1. Introduction

The hypothesis that workers' effort decreases in presence of taxation looks plausible on theoretical grounds, and there is some experimental evidence that apparently provides support to it (Sutter and Weck-Hannemann, 2002; Lévy-Garboua, Masclet and Montmarquette, 2005; Swenson,1988, Sillamaa, 1999). As for the theory, we know that the Nash equilibrium for the private provision of public goods is complete free-riding, hence a taxation may be supposed to have no other effect but a reduction of the wage, which in turns implies, if the labour supply function is as usual, a reduction of effort. It is true that the experimental evidence suggests that people may actually produce privately public goods in excess to Nash equilibrium quantities, to the point that this result has been accepted by textbooks (see f.i. Davis and Holt, 1993, p.365; and Pommehrene and Feld, 1994, for a real-world experiment), but it is hard to infer that the incentive effect of the public good may be superior to that of a private good produced with the same effort/compensation.

However, the theory as outlined to this point is incomplete, as it excludes the possibility that the public good may *by its very nature* move the labour supply curve rightwards. This hypothesis is by no means absurd. The taxation may be used to reduce the risk connected with the effort, thus inducing the concerned subjects to offer *ceteris paribus* more effort. There is no theoretical reasons why this *expected income effect* (positive) should be lower of the *certain income effect* (negative) produced by the taxation. Actually, this is what is argued by a well-developed theoretical model, that of Bird (2001; but see also Sinn, 1995 and Gintis and Bowles, 1982). And it is of some interest that Bird produces a sectional evidence convincingly arguing in favour of the prevalence of the first effect.

A direct result of the simple existence of this theory is that all the experimental evidence quoted above is displaced. In all those experiments the tax revenue was depleted or assigned to other, non-deserving subjects. But we saw that the actual use of the tax revenue may affect positively the effort. It follows that the evidence pointing to a reduction of effort if the tax revenue is depleted is not sufficient to support the conclusion that this is true irrespective of the use of the revenue[2].

Actually, the depletion of the tax revenue implies the acceptance of the Leviathan model of the state. This is a very strong assumption. We think that the textbook definition of the State as a device to resolve market failures is much more realistic from one side and of greater theoretical interest from the other. It is true that the State may run amok and become a Leviathan, or, more often, to expand itself beyond efficiency. But we think that it is more appropriate to see what happens "if the State works well", before turning to the analysis of a rotten case. If a well functioning State is

[2] Note also that the experimental evidence itself, albeit significant, is quite weak, mostly if one consider some methodological perplexities. For a broader discussion of this point, not crucial for this paper, see Ortona *et al.*, 2006.

efficiency enhancing, it is worthwhile to try to build it, while the analysis of the peculiar case of an extremely non-performing State does not say very much[3].

In this paper we present some new experimental evidence on the relation between effort and taxation in presence of a non-Leviathan state, compared with a State of Nature where there is no State. Our State tries to replicate the most basic features of a modern Welfare State, i.e. to provide an universalistic insurance and other universalistic public goods. In order to start with a baseline treatment not too favorable for the hypothesis that the taxation does not necessarily reduces the effort, we assigned to the production of public goods the largest share of the tax revenue. As we will see, our evidence is opposite to that of the literature quoted in the beginning, and provides a preliminary support for the theory of Bird.

The paper is organized as follows. Next section describes the theoretical background of the experimental model. The model itself is described in section 3. Section 4 contains the results, section 5 the main conclusions and section 6 the suggestions for further research - which are more relevant than usual, as the work is still in progress.

[3] Actually, the efficiency of the state may go well beyond what may be argued from the level of the production, as suggested for instance by Osberg (1998) and Bowles (1998). See the last section.

2. The experimental model: theoretical background.

In our experiments we will compare two states of the world, a *state of nature,* were there is risk, and there are no taxes, insurance and public goods; and a *welfare state,* where there is the same risk, a 50% or 30% proportional income tax, a (high but not complete) insurance and a public good. The theoretical previsions of the two approaches discussed in section 1 are the following.

According to the leviathan-State approach, the taxes are by necessity distortionary taxes. If a proportional income tax is introduced, the amount of labor must decrease as the tax rate increases. The amount of labor and income in the State of Nature must be higher than those in the Welfare State.

According to Bird (and Sinn), the subjects face instead a choice problem in a mean – variance (actually, standard deviation) space $\mu - \sigma$. In the State of Nature the level of μ and the level of σ per unit of labor are both higher than in the Welfare State. A lower level of μ leads to a lower effort but a lower level of σ generates a higher effort. We have two opposite effects. In this scenario Bird affirms that the Welfare State "may or may not lower post tax, post transfer income risk". In the former case, the *expected* wage may be higher for a given effort, and the supply curve will move rightward, possibly offsetting the reduction due to taxation. As we mentioned, Bird finds that this is what happens in modern welfare states.

In our experiment, we pay a wage of 1 euro for each unit of labor. Both in the State of Nature and in the Welfare State there is a given probability to loose 50% of the total wage and a second probability to loose it all. In the Welfare State a proportional income tax is levied. Part of the revenue is employed to compensate the unlucky ones. The income of those who lost all (half) the income is restored to 80% (90%) of post-tax, not unlucky income. The remaining of the tax revenue, minus transaction costs (where set), is equally redistributed among the subjects that participate to the Welfare State.

Consequently, The labour in the State of Nature has the following expected marginal benefit:

$$(1-p-q)+0.5p+0q=1-0.5p-q \tag{1}$$

and its standard deviation is equal to:

$$\sqrt{(1-p-q)+0.5^2\,p-\left((1-p-q)+0.5p\right)^2} \tag{2}$$

In the Welfare State, the expected marginal benefit of an unit of labour is:

$$(1-t)(1-0.1p-0.2q)+\frac{(t-(0.1t+0.4)p-(0.2t+0.8)q)(1-c)}{n} \tag{3}$$

and its standard deviation is equal to:

$$\sqrt{\left[(1-t)+\frac{t}{n}(1-c)\right]^2(1-p-q)+\left[0.9(1-t)+0.5\frac{t}{n}(1-c)-0.4\frac{1-t}{n}\right]^2 p+\left[0.8(1-t)-0.8\frac{1-t}{n}\right]^2 q+ -\left[(1-t)(1-0.1p-0.2q)+\frac{(t-(0.1t+0.4)p-(0.2t+0.8)q)(1-c)}{n}\right]^2} \tag{4}$$

where

p: probability of loosing 50% of the income
q: probability to loose all the income
t: tax rate
n: number of individuals in the Welfare State
c: transaction costs (in percentage)

Obviously, (1) > (3) and (2) > (4) for $n > 1$ and $t > 0$. For example, in the Baseline Treatment (BT, see next section, $p = 1/6$, $q = 1/36$, $t = 0{,}5$, $n = 15$ and $c = 0$) the value of (1) is 0.889 and the value of (3) is 0.516, while the value of (2) is 0.239 and the value of (4) is 0.038.
As argued before, we admit that the Welfare State has two functions. The first one is to provide an insurance, i.e. to compensate unlucky people. The second one is a redistributive function. Starting from formula (2), we find the expected value of insurance and redistribution for each unit of labor. The expected value of insurance is

$$(1-t)(0.4p+0.8q) \tag{5}$$

while the expected value of redistribution is

$$(t-0.1pt-0.2qt-0.4p-0.8q)(1-c) \tag{6}$$

In our treatments the value of (6) (between 0.204 and 0.4) is always higher than the value of (5) (never higher than 0.1). This amount to say that we suppose that the redistribution is the main function of our Welfare State. As usual in experiments on public goods, we assume that an egalitarian redistribution is tantamount to the production of an universalistic public good.

3. Experimental design.

The experimental design consists of four treatments, a *Baseline Treatment* (BT), a *High Risk treatment* (HRT), a *Transaction cost Treatment* (TCT) and a *Lower Tax Rate Treatment* (LTRT). All the sessions were run at the Laboratorio di Economia Sperimentale e Simulativa of the Università del Piemonte Orientale, in Alessandria[4]. In all the treatments participants were requested to carry out a secretarial task, i.e. to copy information about fictitious students (matriculation number, name, surname and mark) into a file, in blocs of 9. Each task (i.e., to copy a bloc) was paid 1 euro (before taxes, if the case). After some (non paid) training tasks, participants were requested to choose the number of blocs they wanted to copy. Participants were informed that the computer would signal mistakes and wait for corrections, hence the blocs had to be copied exactly. A 50% fine was established for those who completed less tasks then freely established. After the training task, but before the choice of the number of blocs to be copied, the participants were instructed of the characteristics of their *working contracts*. Two contracts were submitted, one corresponding to the State of Nature (SN) and the other to the Welfare State (WS). Participants were requested to state the number of tasks they wanted to fulfill under each contract, and informed that the assignment to the *actual* contract was to be decided, randomly, only after that (two-thirds of the participants worked under WS contract, one third under SN contract; this information was known at the time of the choice). After choosing the number of tasks, but before the assignment of the contracts, participants were requested to state their preference for a contract, on a 5-point scale (from strong preference for SN to strong preference for WS). There was no time constraint and the end of each session corresponded to the end of the experiment for the last player. There was no show-up fee.

Baseline Treatment (BT). Under the first contract (State of Nature), each participant, after having carried out his job, is asked to cast two dice: if the sum is 2 (1 out of 36) all the earned income is lost, if the sum is 7 (1 out of 6) half of it is lost[5]. The risk is known to participants at the moment of the choice of the number of tasks. In the second contract (Welfare State), the wage and the risk are the same, but the wage is burdened by a 50% tax. However, the participants are announced that the tax revenue will partially refund the unlucky ones, bringing the income of 2 (7) throwers to 80%

[4] The program was written by the programmer of the Laboratory, dr. Marie-Edith Bissey.
[5] Each participant was requested to throw two dice after the completion of the tasks. If the result was 2, all the income was lost; if it was 7, a half. This "experimental risk" is a metaphor for the risks necessarily connected to any economic activity, be it bankruptcy, theft, illness, disappointment or whatever. As we saw, the existence of risk is crucial for the model of Bird.

(90%) of after-tax income. After that, what is left is to be divided equally among all the members of the group, irrespective of individual contribution.

High-Risk Treatment (HRT). The only difference with respect to BT is the probability of loosing half of the earned income, which rises to 16 out of 36 (when, casting two dice, the result is 6, 7 or 8).

Transaction-Cost Treatment (TCT). The only difference with respect to BT is that in the WS contract 10% of the total tax revenue is spent to cover administrative costs.

Low Tax Rate Treatment (LTRT). The only difference with respect to BT is that the tax rate is 30% instead of 50%.

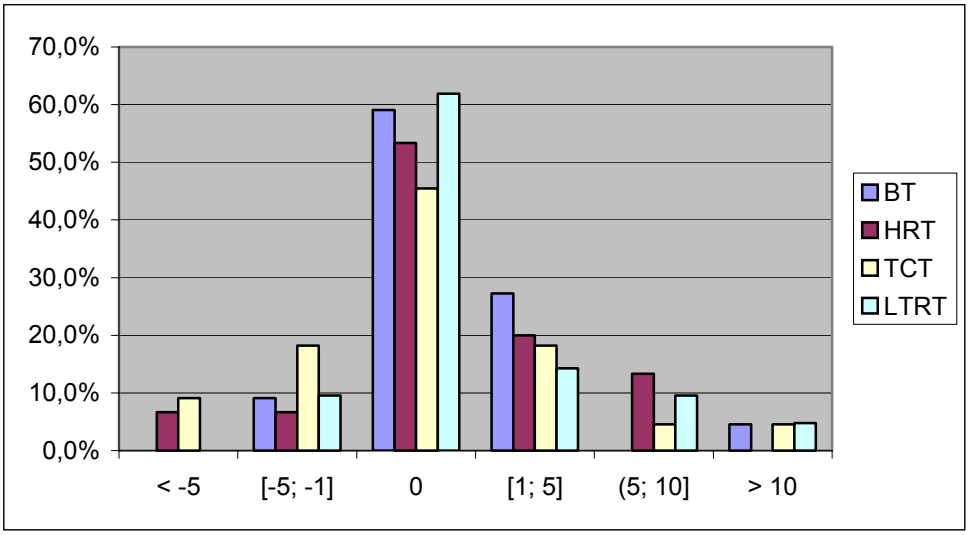
We performed one session for each treatment, each with 21 or 22 undergraduate students of the faculties of Political Sciences and Law, but for HRT, were only 15 showed up. No student took part to more than one session. Overall, 80 students participated to the experiment.

4. Preliminary results.

Result 1. Most people who choose the effort level on the basis of the time they want to devote to the experiment, work the same under both contracts. Most people who choose the effort level only on the basis of the contractual features, work more under WS contract.

In each treatment, most participants decide to exert the same effort under both contracts (see Figure 1). Overall, 44 people out of 80 sign up to work the same under both contracts.[6] This is an interesting result, given that the standard prediction is that taxation crowds out effort.

Figure 1 - Tasks difference[7]



This result is mostly due to subjects who choose the effort level on the basis of the time they want to devote to the experiment (Table 1). 64% of these subjects ("YES" in table 1) exert the same effort under both contracts, while among the others ("NO" in table 1) the share declines to 37% ($p = 0.02$, chi-square test)[8].

[6] We ran the Kruskal - Wallis test to check whether the samples in all treatments came from the same population. We cannot reject the null hypothesis ($P = 0.61$ under contract SN, $P = 0.68$ under contract WS and $P = 0.72$ for the tasks difference). Consequently, we considered them as a unique sample.

[7] The variable 'task difference' for each participant is the difference between the effort under contract WS and the effort under contract SN. This means that a positive value implies a higher effort under contract WS, while a negative value implies the other way round.

[8] We obtain the same result if we run a probit regression where the independent variable is the probability to work the same under both contracts and the regressors are the treatments, the indifference with respect to the contracts and the time motivation. The last variable has a positive and significant effect ($P = 0.03$).

Table 1.
Time statement and effort level[9]

	Number of Tasks		
Time statement	**SN ≠ WS**	**SN = WS**	**Total**
Yes	19	**34**	53
No	17	10	27
Total	36	44	80

On the contrary, if we isolate the 27 subjects[10] who decide their effort without thinking about time but caring the features of the contracts, we find out that most of them work more under contract WS (Table 2; p = 0.004, Fisher exact test).

Table 2.

Contract-feature motivation and effort level

	Number of Tasks			
Contract-feature motivation	**> SN**	**> WS**	**SN = WS**	**Total**
Yes	3	**11**	4	18
No	3	0	6	9
Total	6	11	10	27

Result 2. There is no correlation between preferred contract and level of effort. This is the first of several "invariance" results. We will discuss them in section 6. Data appear in the following four tables. But it is important to emphasize that this result strengthens result 1, as it excludes that the greater effort in the WS may be due to a sort of ideological adhesion to its values.

[9] YES = Effort deduced from the time subjects decide to devote to the experiment. NO = Effort established on the basis of other factors (see the appendix).

[10] We ran the Kruskal - Wallis test to check whether, also in this case, the samples in all treatments came from the same population. We cannot reject the null hypothesis (P = 0.52 under contract SN, P = 0.63 under contract WS and P = 0.96). Consequently, we considered them as a unique sample.

Table 3.

Preferred contract and number of tasks – Contingency table for *BT*

	Number of Tasks			
Preferred contract	**> SN**	**> WS**	**SN = WS**	**Total**
SN	1	5	2	8
WS	1	2	8	11
Indifference	0	0	3	3
Total	2	7	13	22

Table 4.

Preferred contract and number of tasks – Contingency table for *HRT*

	Number of Tasks			
Preferred contract	**> SN**	**> WS**	**SN = WS**	**Total**
SN	1	2	3	6
WS	1	2	4	7
Indifference	0	1	1	2
Total	2	5	8	15

Table 5.

Preferred contract and number of tasks – Contingency table for *TCT*

	Number of Tasks			
Preferred contract	**> SN**	**> WS**	**SN = WS**	**Total**
SN	3	4	7	14
WS	2	2	2	6
Indifference	1	0	1	2
Total	6	6	10	22

Table 6.

Preferred contract and number of tasks – Contingency table for *LTRT*

	Number of Tasks			
Preferred contract	**> SN**	**> WS**	**SN = WS**	**Total**
SN	0	0	4	4
WS	2	4	7	13
Indifference	0	2	2	4
Total	2	6	13	21

A Fisher-exact test shows that, in all cases, there is no significant correlation (P = 0.121, P = 1.000, P = 0.916 and P = 0.581). This means that the preference for a contract did not imply a higher (or a lower) effort level.

Result 3. The risk level does not influence subjects' behavior (see table 7). The differences in effort level in *BT* and in *HRT* are not significantly different (Fisher-exact test, P = 1.000).

Table 7

Tasks and risk

	Number of Tasks			
	> SN	**> WS**	**SN = WS**	**Total**
BT	2	7	13	22
HRT	2	5	8	15
Total	4	12	21	37

In *BT*, the mean number of tasks that participants decided to carry out was lower than in the *HRT*, under both contracts (17.2 against 20.2 under contract SN and 18.7 against 21.5 under contract WS). However, this difference is not significant (Mann-Whitney test, P = 0.396 under contract A and P = 0.381 under contract B).

Result 4. The presence of transaction costs seems to reduce the appeal of the welfare state (see tables 8 and 9). The introduction of a degree of Leviathanism in the welfare state moves the preferences towards the state of nature, and destroys the tendency to make more effort in the welfare state. These results are not significant in themselves (Fisher-exact test, P = 0.182 and P = 0.371 respectively), but the overall result of the TCT is clearly different from the other ones, and deserves a comment. Again, we will make it in next section.

Table 8

Players' preferences – *BT* and *TCT*

	Preferred contract			
	SN	**WS**	**SN = WS**	**Total**
BT	8	11	3	22
TCT	14	6	2	22
Total	22	17	5	44

Table 9

Players' effort - *BT* and *TCT*

	Number of Tasks			
	> SN	**> WS**	**SN = WS**	**Total**
BT	2	7	13	22
TCT	6	6	10	22
Total	8	13	23	44

In the *BT*, the mean number of tasks that participants decide to carry out is slightly lower in contract SN and slightly higher in contract WS than in the *TCT* (17.2 against 17.3 under contract SN and 18.7 against 17.8 under contract WS). However, also this difference is not significant (Mann-Whitney test, P = 0.906 under contract A and P = 0.723 under contract B).

Result 5. The presence of a lower tax rate does not influence subjects' behavior. In *BT*, the mean number of tasks that participants decide to carry out under both contracts is higher than in the *TCT* (17.2 against 15.2 under contract SN and 18.7 against 17.2 under contract WS), but this difference is not significant (Mann-Whitney test, P = 0.463 under contract A and P = 0.686 under contract B), and is contrasted by the opposite behaviors of the medians (15 for both contracts in BT and 17 for both contracts in LTRT).

Result 6. Probably, the presence of the Welfare State increases the productivity.

On average, in all the treatments people work more under contract WS than under contract SN (18.8 tasks against 17.2 in the BT, 21.5 against 20.2 in the HRT, 17.8 against 17.3 in the TCT, 17.24 against 15.24 in the LTRT). If we consider separately the four treatments, both a binomial test (on the number of participants who work more under WS with respect to the number of participants who work more under SN) and a Wilcoxon test suggest that these differences are not significant (but -at 9%- in the BT). However, if we consider jointly the four treatments the significance raises to less than 3% according to both tests. As we saw above, a Kruskal-Wallis test does not rejects the hypothesis that the four samples originate from the same population. Our guess is that the non-significance for the separate treatments would disappear with a higher number of observations. This point deserves a further inquiry.

Result 7. In the BT and in the HRT the number of subjects who prefer the WS is slightly higher than the opposite, but the difference is not significant[11]. As expected, in the LTRT the difference becomes significant (binomial test, 1%, one tail), and in the TCT there is a higher share of subjects who prefer contract SN (the difference is significant at 6%, one tail).

[11] Out of the experimental pattern described in this paper, we distributed a questionnaire to 109 students in different classrooms, putting hypothetical questions, aiming to get rid of the ambiguity implicit in small number experiments. Letting for the moment aside methodological problems coming with the opportunity of comparing "real experimental" with "hypothetical experimental" results, participants faced hypothetical different contracts (still SN and WS, of course), hypothetical efforts and hypothetical wages. Subjects were asked which kind of contract they would sign after graduating, for a trimestral job, if they had the opportunity to choose between a SN and a WS contract. A clear and significant preference for contract WS turned out.

5. Discussion of main results.

Three results deserve a comment. Two will be discussed in this section, the third one in next one, as it has much to do with the suggestions for further research.

The first one is the *there is evidence of a greater effort in the welfare state environment than in the state of nature.* This result must not be overestimated, and should come to no surprise. Suppose a very high risk of losing everything, say 90%. In this case it would be foolish to make any effort in the SN, and we may safely predict a greater effort in WS. In other terms, it looks quite safe to suppose that there are states of the world where the WS is efficiency enhancing. What we obtained is simply a support to this hypothesis.

Nevertheless, to our opinion this result is relevant, for three reasons. First, it confirms that the results of Leviathan State experiments quoted in the first section cannot be generalized outside that (very peculiar) environment. *There is no more valid experimental evidence suggesting that in the real world the taxation reduces the effort.* Second, it brings support to the Bird-Sinn model: *there are*, at least in the laboratory, circumstances where the welfare state enhances the efficiency. Third, the values of our parameters are biased against the hypothesis of the efficiency of the welfare state. The tax rate is high, albeit realistic, and the insurance component of the welfare state (which in the reality includes health services, police, retirement benefits, environment care and so on) is low. Also, the risk is unduly low. In our experiment there is the risk of missing a gain, while in the real world the risk connected with a job failure is normally in nature of a loss; and we know from an enormous experimental literature that a loss is weighted much more than a missed gain. More important, all what you loose in the laboratory is your compensation, while in real life you may loose your job, your family, etc. Hence, would it be possible to make a real world experiment, *the welfare state would probably result more efficient*[12].

The second result deserving a comment is the difference between BT, HRT and LTRT from one side and TCT (the treatment with transaction costs) from the other. To our opinion, this has more to do with perceptions than with economic reasoning. It suggests that subjects are very susceptible towards possible misuses of the tax revenue, independently of its dimension. This may be true, but

[12] If the metaphor for the State is the Leviathan, the experiment on the effect of taxation on the exerted effort is completely in the micro field. But if the State is both tax collector and public services supplier, then the experimental environment must necessarily shift to a macro-scenario. This raises the problem of the generalization to of the results, an issue that should be tackled with great care (and not always is). In the present case, however, further research could actually help, as the problem is not that of the effect of macropolicies, but that of the reaction of the *typical subject* in a given macroeconomic environment.

it may be due only to some framing effect. Further experiments could help[13]. This bring us to the suggestions for further research, hence we move to the last section.

[13] It would be also of interest to test whether this susceptibility is present also with reference to misuses of the private wage ("part of your wage will be used to pay for competitive advertising", for instance).

6. Suggestions for further research.

To our opinion, a very important result is the substantial invariance of the behaviors of the subjects when we changed the risk and the task rate, and also with reference to preference. This may be due to two different (and not alternative) explanations. The first is that subjects "came to play", according to the definition of Carpenter *et al.* (2006): they decided in advance the time to be devoted to the experiments, and they behave consequently. However, there may be another possibility, i.e. that the in the real world too the effort is largely independent from the characteristics of the job contract. Some recent experimental evidence points into this direction (see Burchett and Willoughby, 2004).

Our data provide support for *both* possibilities. From one side, the invariance is strong, and this supports the first hypothesis. From the other, we saw that the nature of the contracts modifies the choices, and this is at odds with the first explanation - players who came just to play may hardly be expected to change *systematically* their behaviour according to a given theory just by chance. Finally, in the accompanying questionnaire we asked explicitly whether (a) the choice of the number of tasks was due to the time they decide to devote to the experiments or (b) to the characteristics of the experiments, or (c) to both. Overall, 33 subjects answered (a), 18 answered (b), and 20 answered (c). This leaves the question open. We are considering some crucial experiments on this point.

Finally, as suggested in fn. 3, the efficiency of the WS should not be reduced to a (possible) greater effort and consequently output. A lower level of risk and a more cooperative environment are economics goods (albeit public) *as such*, and they should be considered in the evaluation of the relative efficiency of a system of taxation-cum-financing, as has convincingly be argued for instance by Osberg, 1998 and by Bowles, 1998. A good experiment should take this featurs into account, despite their intangibility. Probably our data on the preferences provide some preliminary insights.

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