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Redistribution and Production with the Subsistence Income Constraint: a Real-Effort Experiment.*

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Abstract

A large body of literature demonstrates that redistribution leads to inefficiencies due to distorted work incentives. Yet, this result is obtained under the assumption that people are absolutely free in their labor-leisure allocation decisions and that taxation is merely a wage cut. We challenge this assumption and study labor supply decisions in a framework with the subsistence income constraint and a redistribution system which supports disadvantaged players. The results of the real-effort experiment show that the introduction of the moderate subsistence income requirement causes a substantial increase in productivity among taxpayers, with slight additional boost if tax returns are transferred to recipients and not wasted unproductively. As for recipients, the prospect of receiving a transfer significantly enhances their productivity and spurs the overall efficiency leading to a self-sorting of recipients according to their skills.

Keywords: *redistribution, subsistence income, implicit costs of taxation, needy players, meaningfulness of taxation*

JEL-Classification: C91, H21, H24

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1 Introduction

Today as economic inequality is on the rise even in the richest and most equality-oriented economies, negative consequences of inequality start to draw more and more attention (e.g., Piketty, 2014; Staab and Nachtwey, 2016). There is a broad consensus among researchers that increasing inequality may cause severe social and political unrest within societies. According to Joseph Stiglitz, former chief economist of the World Bank, for instance, it may result in increasing societal division, distributive struggle, and even violent conflict (Stiglitz, 2012). Thus curbing inequality is an important goal for every society. There are different approaches to keeping growing inequality in check, which range from radical as, for instance, forms of universal basic income, to more moderate and widespread such as unemployment benefits and family allowances. To many economists, however, redistribution is a cure that is potentially worse than the disease it is supposed to heal. Economists fear that redistribution may harm economic growth, as it distorts labor incentives, and, as such, is associated with high implicit costs. Redistribution advances incentives for leisure and diminishes the individual incentives for work, which leads to reduced overall production within societies.

These concerns stem from the standard economic theory which considers the optimal mix between work and leisure to be an unrestricted choice. That is, within this framework the decision whether to work or not is exclusively driven by the trade-off between the marginal cost of working and the marginal benefit of consumption. The real world, however, is richer. People are subject to important restrictions: they have a basic minimum level of consumption which they cannot undercut. People need a certain income level to support themselves: pay their rent, have a bank account, eat and drink, buy clothing and keep it tidy, have access to telecommunications etc.. These basic expenses cannot be provided for without a basic level of income (subsistence income¹). In other words, without this basic level of income people cannot participate in the normal life of any given society. Hence, the domain within which people can choose between work and leisure is restricted by the subsistence income.

Despite the importance of those restrictions, very little is known about how they influence people's choices. Therefore, our paper takes on the challenge to analyze redistribution in a setting with a minimum income constraint. We study experimentally players' working decision in a real-effort task with a moderate income tax and a subsistence income constraint. We

¹ In this paper, we use the terms minimum income and subsistence income interchangeably, meaning the minimum of level of consumption needed to be a fully functional member of the society.

analyze both the behavior on the supply (taxpayers) and on the demand (transfer recipients) sides of redistribution.

For this purpose, we run a series of real-effort laboratory experiments. Each experiment consists of three phases and is played by pairs of players. In each phase, participants may solve math tasks for 30 minutes and are paid for each correctly solved task. The number of tasks is not limited and, therefore, participants are free to decide how fast (i.e., how hard) to work. In the first phase, all participants are offered pairs of three-digit numbers to add or to subtract. In the second phase, one randomly chosen player in a pair is assigned high productivity while the other – low productivity. The “high productivity” player adds or subtracts three-digit numbers as before, while the “low productivity” player adds or subtracts five-digit numbers. The third phase is equivalent to the first for both players in a pair, but piece rate for a correctly solved task is doubled. Only players who meet a subsistence income threshold are allowed to participate in the third phase. Due to the imposed productivity differences, the subsistence income threshold is easy to reach for “high productivity” players, but extremely challenging for disadvantaged “low productivity” players.

The baseline treatment (BA) follows the described outline without interaction between the players in the pair. Treatment variations introduce a thirty percent income tax for the highly productive players. We then vary the purpose for which tax revenues are spent. In the first experimental treatment (TR – Transfer) tax revenues are transferred to the low productivity player in each pair at the end of the second phase. Thus, the transfer assists systematically disadvantaged players in qualifying for the third phase of the experiment. In two other treatments, OS – Outsider and ST – Stamp, the game is played individually, i.e., there is no disadvantaged player. Thirty percent tax is nevertheless collected and is transferred either to an uninvolved third party in OS treatment, or “wasted” unproductively after collection in ST treatment.

Earlier research on taxation argues that an important factor mediating the implicit costs of taxation is people’s prosociality (e.g., Buch and Engel, 2014). In other words, the more taxation helps those who need help, the less inefficient it becomes. Our experimental design varies the degree by which taxation is “justified” between the treatment condition TR, OS, and ST. At one end of the scale is TR. In this treatment transfer recipients are randomly disadvantaged as compared to taxpayers. Thus, we introduce an unambiguous assignment of “neediness” which does not result from their personal responsibility. Ample evidence shows that the acceptance of redistribution and its implicit costs depend strongly on the perception about the personal responsibility of the recipient for her neediness (e.g., Cappelen,

Hole, et al., 2007; Cappelen, Sørensen, et al., 2010; Fong, 2001). Hence, one could argue that redistribution in TR helps those who deserve support. At the other end of the scale is ST which wastes tax revenues altogether (more details are discussed below). Here, one could argue that redistribution is not justified at all since it helps nobody. Consequently, productivity differences across treatments allow to identify whether the implicit costs of taxation depend on the meaningfulness of redistribution, namely if justified redistribution to needy members of the society leads to different labor responses than wasteful redistribution.

With this general setup, our experimental design complements two streams of literature. The first one studies the interaction between productivity and the size of redistribution (e.g., Meltzer and Richard, 1981)². Results show that high levels of redistribution lead to higher reductions in productivity. Along these theoretical predictions, Agranov and Palfrey, (2015) show experimentally that productivity and efficiency decrease due to higher tax rates. We complement this result in the domain of minimum income restrictions. As we show below, imposing a rather mild constraint leads to substantial effects on productivity, both in terms of significance and magnitude.

The second stream of literature deals with productivity effects of net wage variations induced by either introducing taxes (e.g., Kessler and Norton, 2016) or increasing wages (e.g., Camerer et al., 1997; Fehr and Goette, 2007). For both directions, experimental data reveal important anomalies: field evidence shows that people after a wage increase work less than predicted, suggesting that people have a target income which affects production decisions (see, Farber, 2008). Wage reduction leads to a decrease in productivity. However, people are found to reduce their productivity even further if the decrease in wage is not a simple wage cut, but came about as a result of taxation (Kessler and Norton, 2016). Authors conclude that people are tax averse, that is, their resentment towards taxation exceeds monetary losses associated with it. Our results do not support the latter results on tax aversion but are in line with the literature on wage increases. In all three treatment variations with taxation, we observe not a reduction but an increase in productivity.

The remainder of the paper proceeds as follows. Section 2 overviews the literature, Section 3 introduces the game and our treatment variations. Section 4 sketches our theoretical analysis and develops behavioral hypotheses, while Section 5 reports the results. Section 6 concludes.

² Meltzer and Richard extend the scope of their consideration to the endogenous emergence of tax rates through a democratic process. We, however, consider exogenous tax rates only, as we focus on the interaction between the productivity effects of taxation and the minimum income constraint.

2 Literature

Until recently, justice has been a poorly analyzed topic in economic research leaving this issue to philosophers, political scientists, and sociologists. Therefore, the discussion on the justice of redistribution within economics is rather limited. In contrast, the list of principles of distributive justice suggested and defended by different moral philosophers and social scientists is extensive. A specific perspective on justice is the so called sufficientarian position (e.g. Frankfurt, 2000). This position claims that it is not equality among people that societies should aim for, but a decent minimum standard of living for all its members, above which there is room to improve individually and freely. An attempt to identify such a minimum standard as a set of general needs has been developed by the “capabilities approach” (Sen, 1973, 2000). In this vein, Nussbaum (2000; 2011) has introduced the concept of thresholds for a set of human “functionings” that are required for a dignified life: (A)ll should get above a certain threshold level of combined capability, in the sense not of coerced functioning but of substantial freedom to choose and act (Nussbaum, 2011, p. 24).

Economists, when discussing questions of justice, traditionally focus on two different fairness principles: equity (or accountability) and equality (Konow, 2000, 2001, 2009). The need principle as developed in other disciplines, however, was largely overlooked in economics. Today, however, it is widely accepted in economics and appears to be highly relevant for assessing the degree of justification of redistribution systems (for a broad overview of the topic see Nicklisch and Paetzl, (2017)). For instance, far from being recent, study of Yaari and Bar-Hillel, (1984) shows that as much as 82% of people allocate resources unequally to compensate recipients with higher needs.

Despite this general willingness to redistribute to the needy, inequality is growing even in the most “equal” countries. In this situation, the question of justice and redistribution gains extreme applied importance. According to a former chief economist of the World Bank Joseph Stiglitz, increasing inequality may result in increasing societal division, distributive struggle, and potentially in violent conflicts (Stiglitz, 2012). Inequality if not adequately dealt with can seriously disrupt the functioning of the society.

An obvious way to remedy inequality is the redistribution of wealth. This method is, however, widely opposed by economists since after the standard economic literature (e.g., Feldstein, 1999; Harberger, 1964; Keane, 2011) redistribution interferes with growth: taxing the work income distorts incentives to work and results in a smaller total production within societies. There is, however, evidence that the negative effect of redistribution is at best moderate (Buch and Engel, 2014). There is a number of factors which may play

a role in mitigating the disincentive effects of taxation. For instance, the purpose of redistribution is crucial for its acceptance and its effects on labor supply (Schuitema and Steg, 2008) with specific purposes for its use and transparent spending lowering the implicit costs of redistribution.

Overall, the perceived legitimacy of redistribution is subject to a large heterogeneity, both at an interpersonal level triggered by different degrees of risk-aversion and social preferences (Andersen, 2015; Durante et al., 2014; Moene and Wallerstein, 2001; Sinn, 1996), and at a cross-national level: Aarøe and Petersen, (2014) show that differences in support for redistribution are due to the different default stereotypes about whether welfare recipients are lazy or unlucky.

This leads us to the question whether there is a productivity-redistribution trade-off in the presence of a subsistence income requirement. This question complements earlier experiments on redistribution, which studied the labor supply without subsistence constraints: Agranov and Palfrey, (2015) deal with the interplay between labor supply and the political process that determines the redistribution size within a society. In line with the theoretical prediction, they show that costly investments by players, which in their design correspond to different levels of labor supply, decrease with higher tax rates. In turn, taxes increase the higher the inequality within the experimental society.

Kessler and Norton, (2016) estimate the disincentive effect of taxation on labor supply in a real-effort experiment. For this purpose, they compare wage cuts to income taxes of the same size. They show that the wage cut leads to a significantly lower average decline in productivity than the corresponding income tax. In the following, we analyze whether there is a similar effect in a setting with more refined redistribution system and a subsistence income constraint.

3 Design and Treatments

To measure the production costs of redistribution with a subsistence income restriction and different causes of redistribution we run a real-effort economic experiment. The experiment consists of three phases of 30 minutes each, during which participants can perform simple calculation tasks. The game is played in random pairs, which remain unchanged throughout the experiment. In phase one and three both players compute the sum or the difference of two three-digit numbers. If the task is solved correctly, a new task appears on the screen; otherwise, the same task is presented again. The number of tasks is not limited and, therefore, participants are free to decide how fast, that is,

how hard, to work. The piece rate payment ϕ differs between the first and third phases: in the first (third) phase participants earn 0.05 Euro (0.10 Euro) per solved task. During the first phase, we elicit the motivation and initial ability of the players to perform the task. Note that instructions for phases two and three of the experiment are distributed after the end of phase one. We deliberately opt for a tedious and repetitive task and extended time span to perform this task, so that we minimize the joy and intrinsic motivation of work, and increase the importance of monetary incentives.

The second phase differs in four treatment conditions: Base (BA), Transfer (TR), Outsider (OS) and Stamp (ST). In BA and TR. From the very beginning of the experiment, players are randomly matched into pairs: each pair consists of player R (recipient) and player T (taxpayer).³ The types of players differ only with respect to the second phase: T solves tasks with two three-digit numbers, while R – with two five-digit numbers. Irrespectively of the type of a player, the piece rate is 0.05 Euro per task. Both T and R face a subsistence income threshold: if a player cannot earn the subsistence income (in our case modeled as an exogenously imposed threshold of 3.20 Euro), she can not take part in the subsequent phase three (but waits in the laboratory until the end of the experiment without additional payment). The subsistence threshold is calibrated such that it is on average just too high to be reached by R on her own, but easy to achieve for T. The threshold structure of the experiment justifies redistribution within the society to those who truly need support: without reaching the third phase, players receive approximately 7.5 Euro for 140-minute experiment, which is well below the expectations of the participants.

BA follows this outline without any change; there is no interaction between the players in a pair. TR differs from BA in the sense that player T's income in the second phase is taxed with an income tax (τ) of 30%. Tax revenues are transferred to the paired player R and added to her income from the second phase.⁴ Players T (players R) qualifies for the third phase if the income minus the tax (plus the transfer) satisfies the subsistence income requirement.

In OS and ST, the game is played individually (i.e., there are no disadvantaged players R), but player T is nevertheless taxed with 30% income tax. Comparison between TR and OS as well as ST allows us to see if meaningfulness of the taxation affects the labor supply response to taxation and

³ Different types of players were denoted as type A and B during the experiment to avoid any associations. The meaning and difference between the types as well as why we refer to them as taxpayers and recipients will be explained below.

⁴ We model only net-positions. That is, we do not tax player R and reimburse her afterwards.

thus the implicit costs of redistribution. In OS tax revenue is transferred to an “outsider” (player C). Players C do not take part in any of the working phases of the experiment. They are invited to join the session at the end of the second phase, randomly matched one-by-one to players T, receive tax revenue as a transfer and leave the laboratory. Even if their received transfer is above the threshold they cannot take part in the third phase.

In ST player T writes her postal address on a blank white postcard before the start of the experiment (see Fig.1). Tax revenue is used to buy postal stickers.⁵ The value of each sticker equals tax revenue of the respective player.⁶ The postcards are sent to the provided addresses immediately after the experiment. Thus tax revenue is wasted (taxpayers themselves do not profit from the way taxes are spent), but taxation cannot be interpreted as a mere wage cut. The crucial difference of ST from other redistributive treatments (i.e., TR and OS) is that the labor response to taxation in ST is not affected by prosociality. For Y_i denoting i 's correctly solved tasks in the second phase, Table 1 summarizes the payoffs of the second phase in all treatment conditions.

Table 1: Payoffs in the second phase by treatment and player type.

Treatments	Player T	Player R	Player C	Number of obs. ⁷
BA	ϕY_T	ϕY_R	–	32
TR	$(1 - \tau)\phi Y_T$	$\phi Y_R + \tau(\phi Y_T)$	–	30
OS	$(1 - \tau)\phi Y_T$	–	$\tau(\phi Y_T)$	30
ST	$(1 - \tau)\phi Y_T$	–	–	30

Our design incorporates three important features to address our research question. First of all, we introduce a one-to-one correspondence between taxpayers and transfer recipients. Player T is individually responsible for determining the size of the transfer to R and thus there is no coordination problem among several players T.

Secondly, due to the predetermined direction of transfers, subjects know in advance whether they are taxpayers or transfer recipients. The choice of a systematically disadvantaged player within the pair is random and therefore transfer recipients both deserve support without any doubt and can not

⁵ A postal sticker is a sticker with a QR code, which analogously to a stamp is used to pay for postal services (see Fig.1).

⁶ All actual tax revenues in the experiment exceeded the price of sending a postcard.

⁷ Number of independent observations, i.e., the data for a pair of players in BA and TR and for individual players in OS and ST.

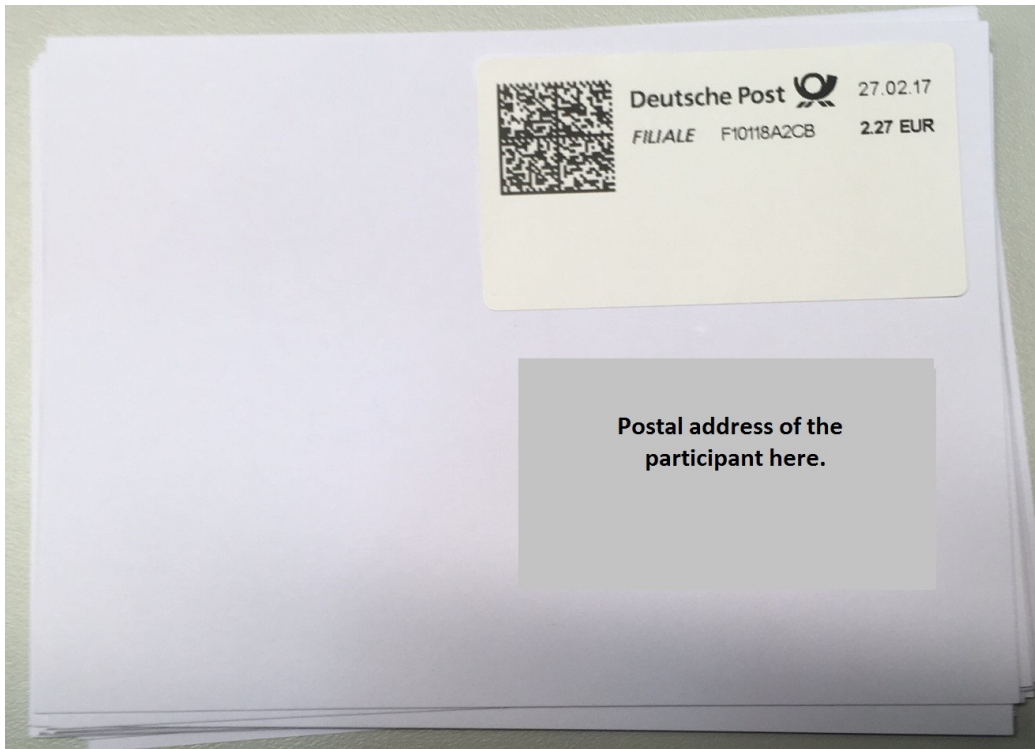


Figure 1: Example of the postcard from Stamp treatment.

be held accountable for their lower productivity. Accountability principle was proved to play a role in redistribution decision (Cappelen, Konow, et al., 2013), however, it is not applicable in this environment. Although accountability is questionable in many real-world situations, we deliberately eliminate this type of uncertainty as this is not the focus of our research.

Third, we create the least favorable conditions for redistribution by reinforcing the entitlement towards one's earnings. As previous studies on donation show (e.g., Cherry et al., 2002; Ogawa et al., 2012), if donors earn incomes (i.e., they work for their incomes), they are less likely to redistribute. In our experiment, we use a real-effort task making taxpayers feel entitled to their earnings and thus less willing to transfer. So in contrast to earlier experiments (e.g., Agranov and Palfrey, 2015), our design diminishes the easiness of giving.

3.1 Procedure

The experiment was conducted at the Wiso research Lab at the University of Hamburg using *z-tree* (Fischbacher, 2007) in spring 2016 with some ad-

ditional sessions in winter 2017. Subjects were mostly students of various majors of the University of Hamburg, recruited online via hroot (Bock et al., 2014) and randomly assigned to treatments. No subject participated more than once.

Before the beginning of the experiment, participants placed their cell-phones into the provided envelopes and sealed them. They had access to the envelopes only after the payment. In addition, participants were asked to keep their bags and personal belongings outside of their cubicles. Thus, participants had no phones or calculators to help them solving the tasks. Pen and paper were provided to be used for calculations. After that, participants were seated in cubicles and received a copy of the instructions for the first phase. Additionally, the instructions were read aloud. Subjects were randomly matched in groups of two, which remained unchanged throughout the experiment and played simultaneously, but independently from other pairs. Before any action took place a type of the player within the pair was displayed on her screen.⁸ After the end of phase one, instructions for the rest of the experiment (second and third phases) were distributed and read aloud. After each phase players had a short break of three minutes.

We conducted 12 sessions with 184 participants in total. Sessions ran with 16-20 subjects per session for BA, TR and OS and with 15 subjects for ST yielding ca. 30 independent observations per treatment (see Table 1). At the end of the experiment, subjects were paid privately and in cash. Payments ranged from 3.40 to 54.90 Euro with an average of 25.80 Euro for approximately 140 minutes.

4 Hypothesis

4.1 Effort provision without redistribution

In the following, we assume that players hold a twice differentiable, additive utility function with concavely increasing benefits and convexly decreasing working costs. Both, benefits and costs depend on effort. Effort subsumes in our experiment a combination of endeavor and skills. Therefore, we expect players to differ with respect to their costs (i.e., their skills). That is, for two players i and j we label player i as more talented than player j if for every given work speed \bar{v} it holds $c_j(\bar{v}) > c_i(\bar{v})$. In turn, players gain benefits from working which depends on ϕ (the piece rate payment) and the work speed (per minute) v_i (i.e., their endeavor) such that $Y_i = 30v_i\phi$. In sum,

⁸ Although types were revealed, the actual difference between types was made clear only after the end of phase one.

this yields

$$u(v_i) = w(\phi v_i) - c_i(v_i) \quad (1)$$

such that utility u_i of player i depends on the benefit w with $\dot{u}(w) > 0$ and $\ddot{u}(w) < 0$, and the individual costs c_i with $\dot{c}_i > 0$ and $\ddot{c}_i > 0$. It holds that $\dot{w}(v_i) > 0$ and $\ddot{w}(v_i) < 0$, and $\dot{c}_i(v_i) > 0$ and $\ddot{c}_i(v_i) > 0$.

In the first and – if possible – the third phase of the experiment, players maximize their utility by choosing v_i such that $\phi \dot{w}(\phi v_i) = \dot{c}_i(v_i)$ (first order condition). In the second phase, we have to consider that v_i may or may not be high enough to qualify i for the third phase. To qualify $3\phi v_i \geq S$ with S being the subsistence income. Thus, i 's utility function changes to

$$u(v_i) = \begin{cases} w(\phi v_i) - c_i(v_i) & \text{if } 3\phi v_i < S, \\ w(\phi v_i) + U_i - c_i(v_i) & \text{otherwise.} \end{cases} \quad (2)$$

for U_i denoting i 's expected utility in the third phase. This creates the incentives for players in the “medium effort cost range” to choose a work speed which allows them to just reach the subsistence income. Observe that the subsistence income requirement creates a discontinuous first order derivative of the marginal benefit of income. Specifically, for v_i'' such that $\phi v_i'' \neq S$ we have $\dot{w}(v_i'') = \phi \dot{w}(\phi v_i'')$, whereas for v_i' such that $\phi v_i' = S$ we have $\dot{w}(v_i') = \phi \dot{w}(\phi v_i') + U_i$.

Therefore, player i chooses a work speed such that they just reach the subsistence income if (i) $\phi \dot{w}(\phi v_i') + U_i \geq \dot{c}_i(v_i')$, and $\phi v_i' = S$, but (ii) $\phi \dot{w}(\phi v_i'') < \dot{c}_i(v_i'')$ for all $v_i'' > v_i'$. That is, they will choose neither a higher work speed, since this violates the first order condition (ii), nor a lower work speed, since this violates first order condition (i).

On the other hand, player i chooses a work speed which leads to an income below the subsistence income if (iii) $\phi \dot{w}(\phi v_i') + U_i < \dot{c}_i(v_i')$, and $\phi v_i' = S$. Again, any choice of v_i' and beyond – due to the concavity of $w(\cdot)$ – violates the first order conditions (iii).

Finally, player i chooses a work speed which leads to an income higher than the subsistence income if (iv) $\phi \dot{w}(\phi v_i'') \geq \dot{c}_i(v_i'')$ for some $v_i'' > v_i'$ and $\phi v_i' = S$. Any choice below the largest v_i'' violates the first order conditions (iv).

Overall, both for players R and players T, one can predict a partition of players into three groups. The first group chooses a work speed which yields an income below the subsistence income requirement. Within this group, people increase their work speed if they are better at solving the tasks (i.e., if they have lower effort costs). The second group chooses a work speed which yields an income at the subsistence income threshold. All players within this group choose this speed regardless how good they are at solving

the tasks. Finally, players in the third group choose a work speed which yields an income beyond the subsistence income requirement. Within this group, people increase their work speed if they are better in solving tasks.

4.2 Effort provision with taxation

When analyzing the choice of a work speed in the treatments with redistribution, one has to consider two types of players separately. For players of type T, the piece rate per solved task ϕ decreases to $(1 - \tau)\phi := \phi'$. For players of type R, the subsistence income requirement S decreases to $S - \Phi := S'$ with Φ being the expected transfer they receive from their matched taxpayer.

Replacing ϕ with $\phi' < \phi$, it thus becomes “harder” for a taxpayer to meet the subsistence income requirement, as they earn only $(1 - \tau)\phi$ for each task. This implies that the range of the three groups of players “moves to the right”: a broader range of potential optimal work speeds now belong to the first group earning less than the subsistence income, while a smaller range of players choose a work speed leading to more than the subsistence income. Finally, taxpayers who were to choose a work speed leading to an income beyond the subsistence income now choose a work speed corresponding with the subsistence income. In turn, replacing S with $S' < S$, it becomes “easier” for transfer recipients to meet the subsistence income requirement implying that the range of the three groups of players “moves to the left”.

In other words, from a theoretical point of view, redistribution is nothing more than a wage cut for taxpayers, similar to Kessler and Norton, (2016), and an expected decrease in the subsistence income threshold for transfer recipients. Since we introduce a one-to-one relation between taxpayers and transfer recipients in our game and the former are overall more productive than the latter, we can hypothesize:

H_I : Redistribution imposes implicit costs since players produce in total less in TR than in BA.

Previous studies have shown that the meaningfulness of taxation is crucial for its acceptance and its implicit costs (Schuitema and Steg, 2008). In TR transfer recipients are disadvantaged and assigned some “neediness” which does not result from their personal responsibility.⁹ Therefore, we set up a

⁹ According to Brock and Reader, (2002, p. 433): “An agent has an obligation to help a person in need, if the following conditions all hold, *ceteris paribus*. For the needy person, severe harm is likely and imminent. He is unable to help himself. He is in his position through causes beyond his control, and it is not the case that he has an informed, voluntary, and enduring desire not to be helped. The agent knows about the needy persons position, knows what is required to help avert the harm, is in a

situation in which redistribution is clearly justified and meaningful: without transfers, it is almost impossible for players R to meet the subsistence income requirement.¹⁰

In turn, the meaningfulness of taxation decreases in the treatment conditions OS and ST. While transfers in OS are at least received by another participant whose neediness is highly questionable, ST wastes the tax revenue altogether. It seems that taxation is less justified in these treatments implying that inefficiencies should increase.¹¹

H_2 : Decreasing the meaningfulness of taxation causes further inefficiencies: Players T produce less in OS and in ST than in TR.

5 Results

Our data set consists of 32 pairs (i.e., independent observations of 31 players T and 32 players R) for BA, 30 (30 players T and 30 players R) for TR, 29 players T for OS and 29 for ST.¹²

As expected, performance of the subjects in all treatments in the first phase is very similar with ca. 130 tasks solved on average in 30 minutes

position to help such that the cost of helping is not significant, and her assistance has some good likelihood of being effective. Under such conditions, we can reasonably claim that the agent would be morally required to help the needy person.”

¹⁰ We motivate the existence of the threshold and potential income discontinuity by the sufficientarian tradition (as argued in, e.g., “poverty threshold” Benbaji, (2006)): every individual has needs which have to be satisfied at a commonly accepted minimum level to be able to take part in the economic, social, and political life of a given society. For the rather artificial experimental threshold to be perceived as such minimum income level, the participation in the last phase of our experiment is conditioned upon reaching the threshold in the previous phase. Reaching the third phase is made more important by the experimental design through doubling up of payoffs. That is, if a person does not earn enough to ensure her subsistence, she can be considered to be too exhausted to take part in future rounds of production. The threshold is calibrated as required by Brock and Reader, (2002) so that “the cost of helping is not significant” (relative to both earnings in the whole and in the phase of the experiment) and “her assistance has some good likelihood of being effective.”

¹¹ One may argue that ST is the least meaningful of all three treatment conditions, since tax revenues are wasted. Hence one may expect players T to work less in ST than in OS. However, if one assumes taxpayers to be inequality averse, one can think of taxpayer preferring situations in which some of her money is destroyed over situations in which she has to share her money with some undeserving outsider (e.g., in the modified dictator games analyzed by Lazear et al., 2012).

¹² We removed three participants (one participant in BA, one in OS and one in ST) from the sample and did not use their data in the analysis since individuals behaved non-systematically different (i.e., their choices were more than 2.5 standard deviations from the mean of relative performance measured as described below).

(see Fig. 2). To measure the performance of the participants controlling for their initial ability we divide the number of correctly solved tasks in the second phase by the number of correctly solved tasks in the first phase.¹³ We further on call this relation between the stages “relative performance”. The relative performance of 1 means that a player solves in the second phase exactly the same number of tasks as in the first one; a number less than 1 means that she reduces her effort and solves less, and the number more than 1 means respectively that she improves her performance. Thus, one can also interpret relative performance as a percentage of change as compared to the first phase.

We calibrate the subsistence income requirement such that it provides an extremely mild restriction for players T. Fig.3 displays how restrictive the imposed subsistence income threshold is for every individual as well as individual response to the introduction of taxation. Blue bars show how players T need to adjust their performance in the second phase in order to meet the subsistence income requirement; the vast majority of players could lower their performance considerably and still meet this requirement. Therefore, in line with the H_1 , we expect a negative response to taxation (i.e., relative performance less than 1), namely, we expect players T work less in the second phase in TR, OS and ST. Red bars show the actually observed relative performance, the average relative performance observed in BA is indicated with the dashed orange line.

Figure 4 displays the response to taxation on the aggregate level. On average, players enhance their relative performance slightly in BA. As our experiment lasts over 140 minutes in total with 90 minutes of active calculations, throughout the experiment we observe both effects of learning and fatigue. However, there is no reason to believe that these effects are treatment specific and, thus, the net effect of both learning and fatigue reflects the mild increase of relative performance in BA. Beyond this increase, we see the effect of taxation. In sharp contrast to H_1 , the effect is positive, largest in TR, less pronounced in OS and in ST.

In the following, we first consider the effects of redistribution on taxpayers, then on transfer recipients and afterwards analyze the time dynamics of exerted effort.

¹³ To check the robustness of our results we also try alternative measures, such as relative performance defined as difference between performance in the second and first phases (as in Dreber et al., (2011) and Kessler and Norton, (2016)). Our main findings hold.

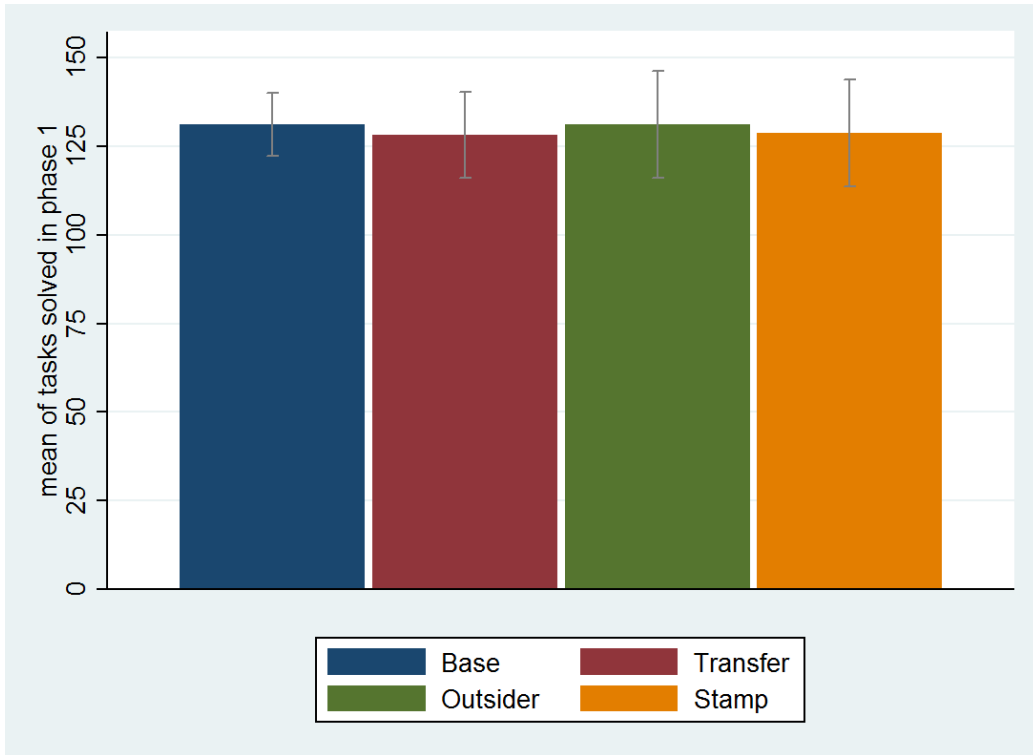


Figure 2: Number of tasks solved in phase one per treatment. 95% confidence interval.

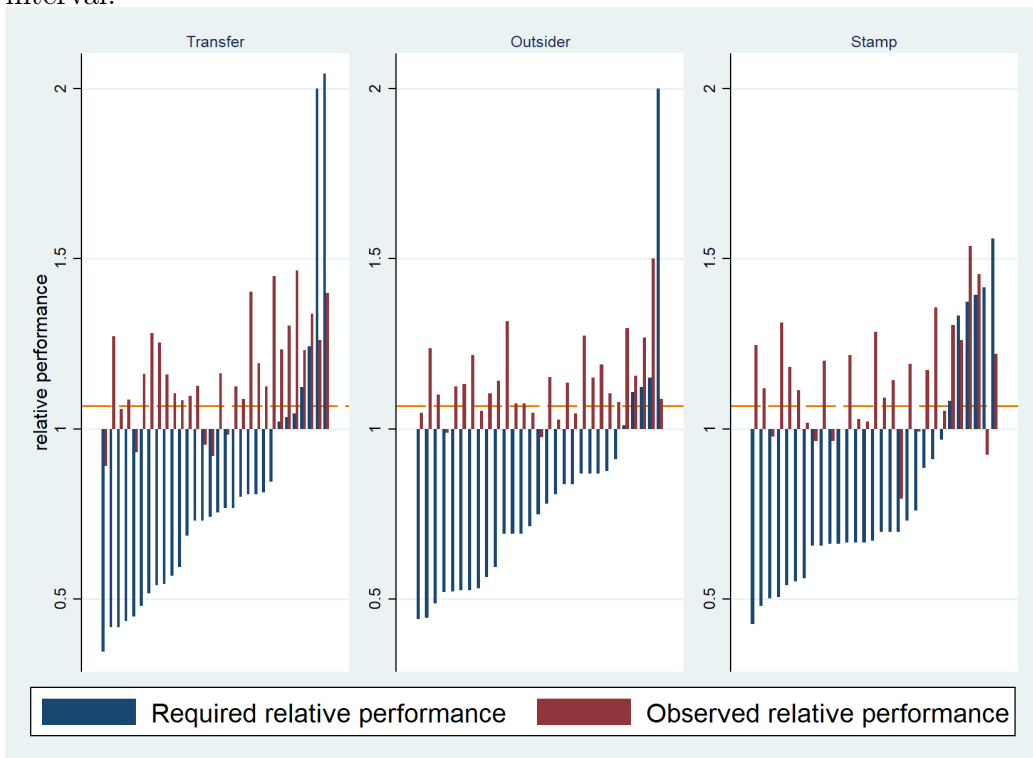


Figure 3: Relative performance required to reach the subsistence threshold and actual relative performance for each taxpayer. Dashed line depicts the median relative performance in the Base treatment.

5.1 Does taxation influence relative performance?

Unlike experimental evidence on taxation without subsistence income requirement (e.g., Kessler and Norton, 2016), we find no evidence that taxpayers reduce their working effort due to the introduction of taxation. As already mentioned above, the result is not driven by the presence of the minimum income threshold as such since the threshold is easily reachable. Brookins et al., (2017), for instance, demonstrate that goals that are easily attainable do not have positive effects for production.

Mann-Whitney U-test confirms that relative performance in TR (1.17) and OS (1.14) is higher and significantly different from BA (1.08 $p=0.005$ for TR and 0.03 for OS).¹⁴ The difference between BA and ST (1.14 $p=0.12$) is not significant (see 4). Therefore, our first result is

Result₁: Players T produce significantly more in TR and OS than in BA.

One obvious candidate driving the differences in relative performance among treatment conditions is efficiency-seeking. If transfer recipients keep producing in the third phase, the overall efficiency of the society will be higher, and thus they should be assisted. By comparing OS and TR we can identify this motive. In OS recipients do not take part in the next production phase even if they pass the threshold through the received transfer. Following the logic of efficiency-seeking taxpayers, there should be more production in TR than in OS. However, we observe no differences in performance in OS and TR, which may mean that efficiency-seeking is not the primary motive for production and that transfers in OS are not considered to be wasted. Outsiders are seen as needy, since their payout from the participation in the experiment (however short it was) depends solely on the performance of the taxpayer. Although recipients in OS are not systematically disadvantaged by the design of the experiment, their needs are still accepted by the taxpayers. Thus, the needs principle of redistribution is apparent to the participants even without reinforcing it artificially (Brock and Reader, 2002). Confirming the result of Cappelen, Moene, Sorensen, et al., (2008), people react to the needs principle not only in the context of “rich country” helping the “developing country” (i.e., advantages players helping disadvantaged players in TR), but also among peers (students helping students in OS).

In the theoretical analysis, we showed that taxpayers who are better at solving tasks respond negatively to the taxation (i.e., withdraw their effort), while productivity in the “medium range” remains the same. To see whether players react heterogeneously to the tax, we classify taxpayers as talented

¹⁴ All non-parametric statistical tests reported are two-tailed taking individuals as units of observations.

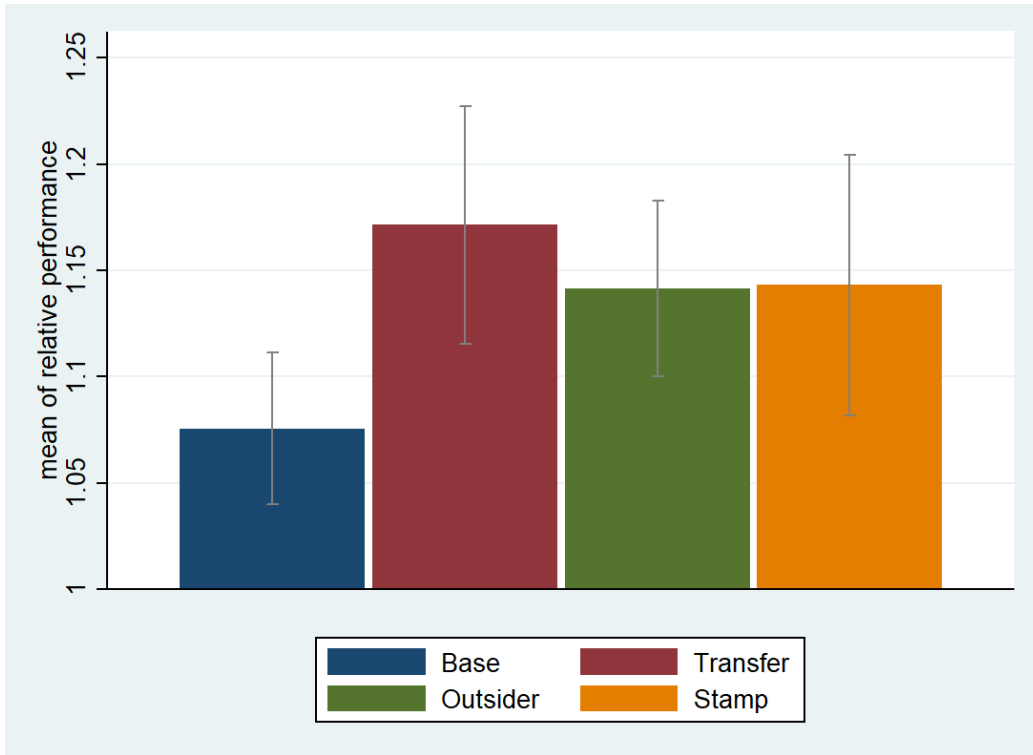


Figure 4: Relative performance of players T across treatments. 95% confidence interval.

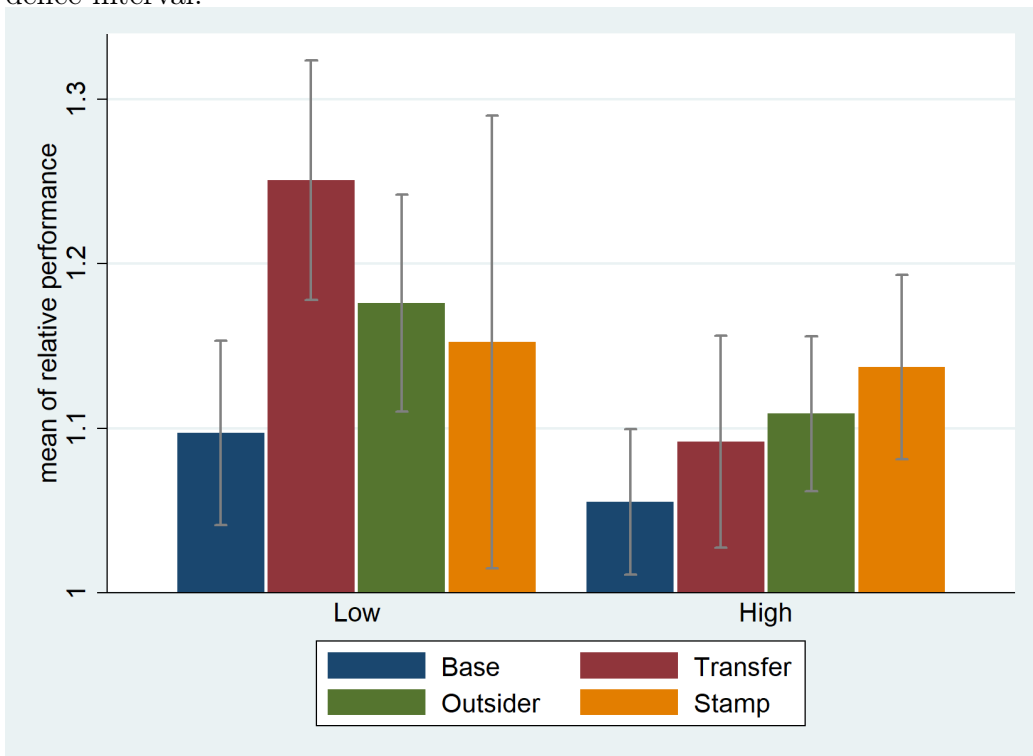


Figure 5: Relative performance of high and low talent players T. 95% confidence interval.

or not talented according to their performance in the first phase: those who are above their treatment’s median production are considered talented and non-talented otherwise.¹⁵ As shown in Fig.5, low talent taxpayers are more sensitive towards treatment manipulations. That is, low talents exert significantly higher effort in TR (1.25) and OS (1.18 $p=0.003$ for TR and $p=0.097$ for OS) as compared to BA (1.10). TR is borderline insignificant as compared with OS ($p=0.12$), which allows us to partly confirm H_2 : The data suggest that meaningfulness of taxation is of importance for low talent taxpayers.

In contrast, high talent taxpayers are rather insensitive towards the 30% taxation: the increase in productivity is rather small, relative performance in TR (1.09) and BA (1.06) does not differ significantly ($p=0.28$), but relative performance in OS (1.11) and ST (1.14) is significantly higher than in BA ($p=0.09$ with OS and $p=0.06$ with ST). These observations are surprising at the first glance, since the “wasteful” redistribution leads to the highest productivity among highly talented taxpayers. It, however, may be explained by the accountability principle. Although transfer recipients were randomly chosen to be disadvantaged, it appears that highly industrious taxpayers due to own above average productivity may believe that the threshold is easily reachable even with the disadvantage and hold transfer recipients responsible for not meeting it. That is, highly talented taxpayers underestimate the support required by the recipient and decrease their effort. Cappelen, Moene, Skjelbred, et al., (2017) observe that people tend to overestimate the role of merit in the outcome and underestimate the role of the brute bad luck, which is consistent with the behavior we observe among high talent taxpayers. In ST treatment there is no recipient of the transfer, therefore performance is not affected by the considerations mentioned above.

Comparing the relative performance of low and high talent taxpayers, there are significant differences within TR and OS, but not in BA and ST (within TR $p=0.005$, OS $p=0.097$). That is, unlike meaningless taxation, taxation for redistribution causes heterogeneous responses within the population. Summarizing our results for taxpayers, we find:

Result₂: Redistribution in favor of other people (i.e., TR and OS) barely affects the relative performance of high talent players, but enhances the relative performance of low talent taxpayers.

To capture the presence of heterogeneous treatment effects in greater detail, we run a quantile regression (Koenker and Hallock, 2001) with relative performance as dependent variable and treatment as an explanatory factor

¹⁵ The medians in the first phase are 130 tasks in BA, 123 tasks in TR, 121 tasks in OS and 134 correctly solved tasks in ST.

variable. Fig. 6 is a summary of quantile regression results for this specification. We have three covariates plus an intercept. For each of the three coefficients, we plot distinct quantile regression estimates ranging from 0.05 to 0.95 as the solid green curve.¹⁶ For each covariate, these point estimates may be interpreted as the impact of a one unit change of the covariate on relative performance holding other covariates fixed. Thus, each of the plots has a horizontal scale of quantile and the vertical scale that indicates the effect of the covariate. As our measure of relative performance is normalized, we can interpret the coefficient as percent of change. The dashed line in each figure shows the ordinary least squares estimate of the conditional mean effect with the two dotted lines representing conventional 90 percent confidence interval for the least squares estimate. The shaded area depicts a 90 percent confidence band for the quantile regression estimates. BA is a reference category and therefore the intercept of the model may be interpreted as the estimated conditional quantile function of the relative performance distribution of a person in BA. Since the intercept is a combination of the constant and the effect of Base (the reference group), it is impossible to disentangle them. We see heterogeneous effects which are different from the conditional mean OLS.

Looking into our treatment differences, it can be seen that OS affects all the quantiles rather homogeneously with ca. 7% increase in relative performance due to being in OS treatment. On the contrary effects of TR and ST are more heterogeneous. If player belongs to the lower effort quantiles we observe the coefficient close to 0 in both treatments, which goes up to 0.20 for top quantiles. That is, if one belongs to the higher effort quantile, she solves 20% more due to the fact that you are in TR treatment variation.

5.2 Do transfers influence relative performance?

Farkas et al., (1996) find that 65% of Americans (participants of the Public Agenda survey) claim that the most “upsetting” thing about transfers and redistribution is that “it encourages people to adopt the wrong lifestyle and values” (ibid, p.9). In our experiment, we fail to find support for this opinion. On the contrary, we find that under the redistribution system, the productivity of the transfer recipients is higher with a stronger effect for the less productive recipients (see Fig.7 and the cumulative distribution function of relative performances in Fig.8).

On average, we see that transfer recipients enhance their relative performance in the environment with the transfer (0.48 in BA and 0.55 in TR,

¹⁶ Please note that quantiles refer to the distribution of the dependent variable, namely, relative performance.

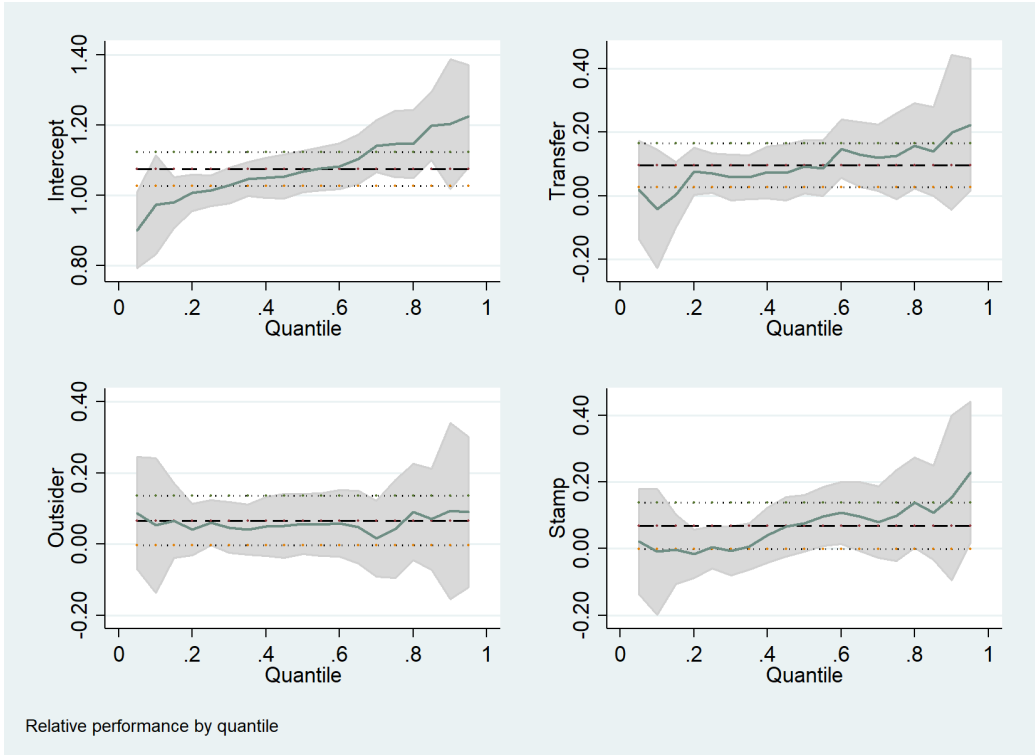


Figure 6: Quantile regression results: effects of treatment on relative performance among taxpayers.

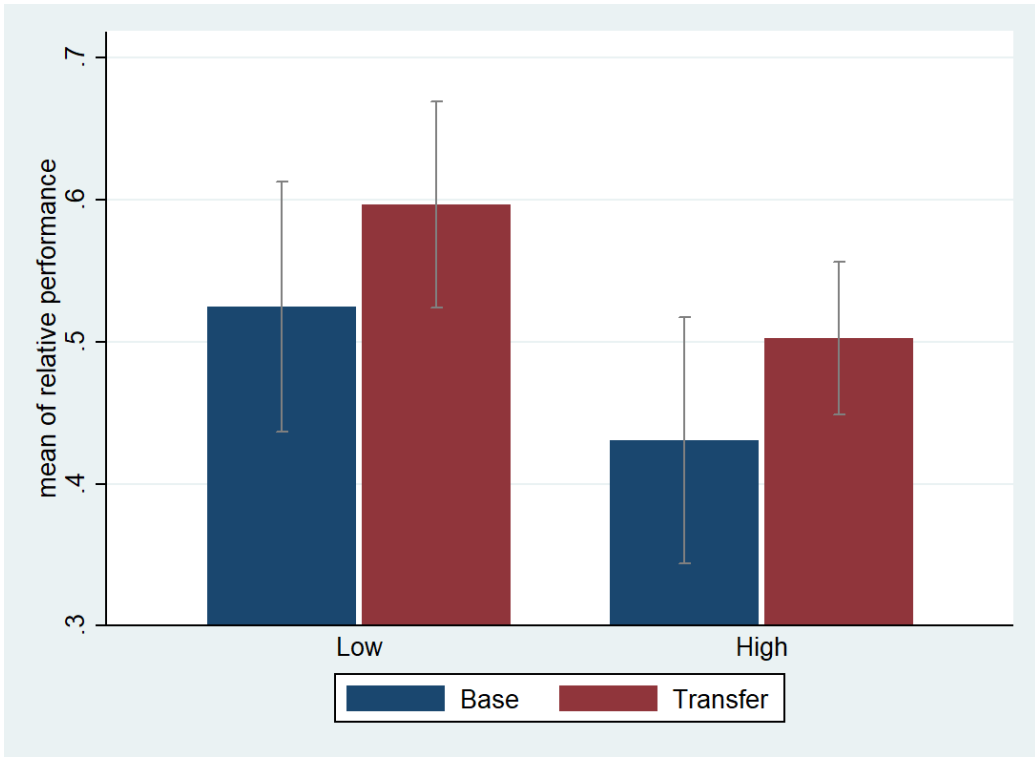


Figure 7: Relative performance of high and low talent recipients.

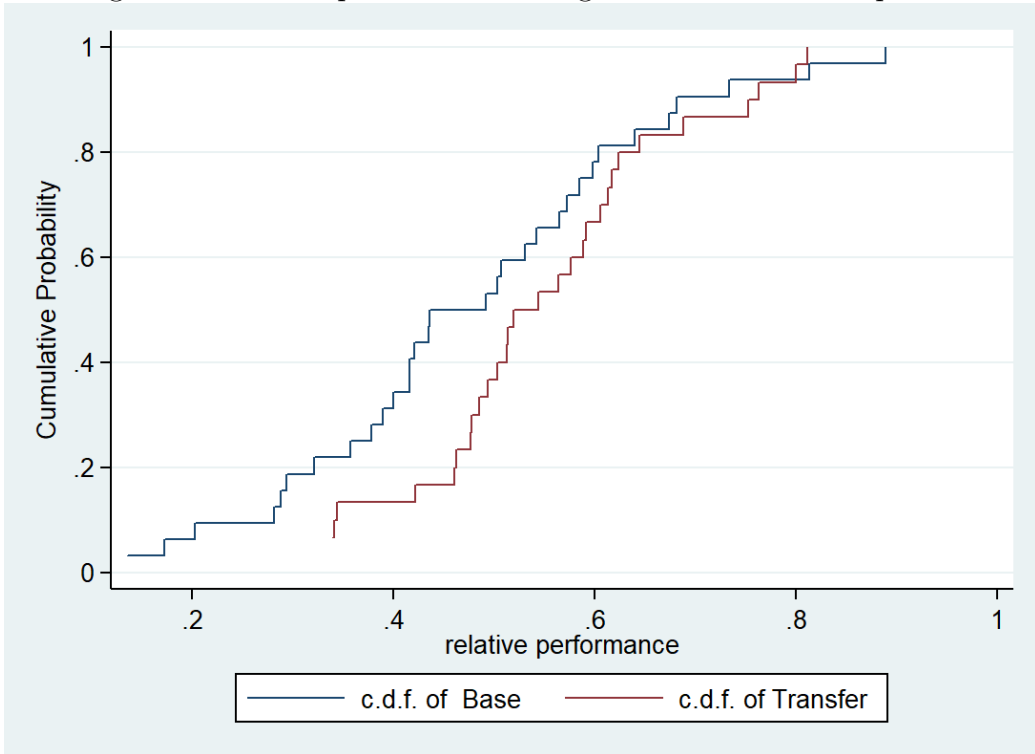


Figure 8: Cumulative distribution function of relative performance for players R

$p=0.07$). This difference may arise from the higher expected payoff of the recipients in TR. In line with the theory, the subsidy increases the likelihood of reaching the third phase. Since exceptionally industrious players may reach the subsistence threshold without assistance the transfer does not affect their labor supply. For less industrious recipients transfer plays a more important role, since the transfer is decisive for their taking part in further production. This intuition is confirmed by the data. We group transfer recipients into high and low talent according to the mean of the treatment performance in the first phase and analyze the differences in relative performance among these groups. The relative performance does not significantly differ between high (0.52) and low (0.43) talent subjects in BA ($p=0.18$). In other words, players of high and low talent work equally hard. As for the difference between low (0.60) and high (0.50) talents in TR, it is significant ($p=0.02$) with low talent players displaying higher relative performance. That is, with redistribution even low talent players have a chance to take part in the third phase, and so they boost their performance. Fig.8 presents the cumulative distribution function of relative performance for the transfer recipients. One can see that the main difference in the distributions between BA and TR comes from the enhanced productivity of the participants with low relative performance. As such, redistribution motivates low productivity recipients, those who need support the most, to exert effort. Summarizing the findings:

Results: Redistribution leads to higher productivity among the transfer recipients, especially boosting the performance of low talent recipients.

Importantly, redistribution fosters better self-selection of players: among recipients, the correlation between the performance in the first and second phase is higher in TR than in BA (0.71 compared to 0.39 in BA). It means that in TR players who are more able also are more likely to perform better in the second phase, while in BA the production among the recipients is less systematic and more unpredictable.

5.3 Does passing the threshold affect the performance of taxpayers?

Research on productivity (e.g., Kool et al., 2010) shows that people have limited computational capacities and are likely to optimize the distribution of their effort, that is, to work harder on the tasks with higher payoffs. In our experimental environment with the presence of the subsistence income and a “tax-free” production in the third phase, it would be rational for taxpayers to either completely stop working or to slow down after securing own participation in the more profitable third phase.

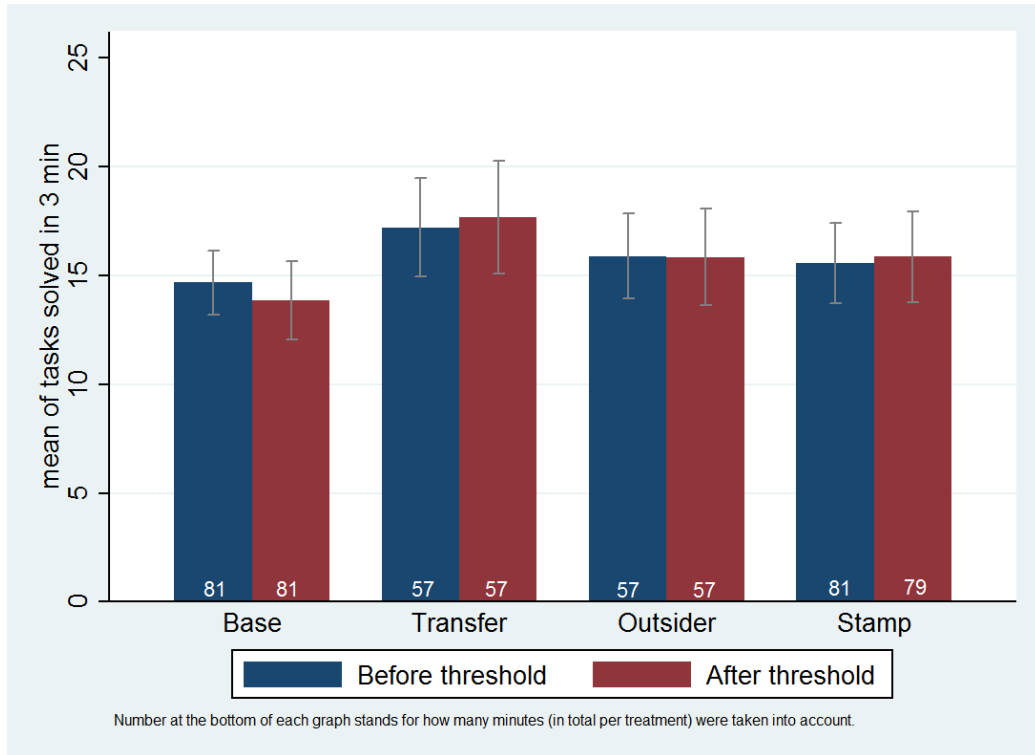


Figure 9: Mean of the number of correctly solved tasks 3 minutes before and after the threshold. 95% confidence interval.

To detect the change in the speed of production due to the threshold we look into the speed of production during the time just before and after the threshold. Fig. 9 displays the performance of players three minutes (i.e., 10% of the phase time) before and after the threshold. It is possible that not all taxpayers have reached the threshold at least 3 minutes before the end of the phase and thus the average number of tasks after the threshold may be affected by dropping out of slower players. In other words, fast players produced for 3 minutes before and 3 minutes after the threshold, while slowest players produced for 3 minutes before and e.g., 2 minutes after and thus the average may be influenced by the lower number of slower players after the threshold as such. Although we can not eliminate this bias completely, Fig.9 shows how many minutes were taken into account for calculating the aggregate (white numbers at the bottom of each bar)¹⁷. As one can see, the number of observations is equal on both sides of the threshold for all treatments but ST where two players had only two minutes left after the threshold. We observe that in all the treatments the speed of production does not change with passing the threshold. Wilcoxon signed-ranks test confirms that the speed of production is not significantly different three minutes before and after the threshold (for BA $p=0.26$, for TR $p=0.46$, for OS $p=0.90$, for ST $p=0.60$). This result reconfirms that the threshold is not seen as an income target.

6 Discussion and Conclusion

We run a real-effort experiment to measure the effects of redistribution on the labor supply of both taxpayers and transfer recipients. In contrast to previous experiments, we restrict labor-leisure choices by the introduction of a subsistence income threshold which players have to meet in order to continue their participation in the experiment. Additionally, we test whether meaningfulness of redistribution has effect on productivity.

Overall productivity of the taxpayers in TR increased by 7.6% in BA, by 17.1% in TR, by 14.1% in OS, and by 14.3% in ST. While one can attribute the productivity increase in BA to the interplay between subjects' learning and getting tired, the differences among other treatment conditions are associated with the introduction of taxation. These results question the predictions of the standard theory and complement earlier field evidence (e.g., Buch and Engel, 2014). It seems that the behavior of taxpayers is similar to

¹⁷ Time data are missing for some sessions in BA, TR and OS, therefore the results are rather exploratory. The graph is based on the data for 27 taxpayers in BA, 19 taxpayers in TR, 19 in OS, and 27 in ST.

the behavior observed in the experiments with wage variation (e.g., Camerer et al., 1997; Fehr and Goette, 2007). These studies find that there is no unidirectional adjustment of labor supply when wages vary. They highlight the importance of target incomes for the changes in labor supply associated with varying wages. When facing a wage cut induced by taxation, taxpayers in our experiment try to compensate for the loss of income by working harder.

Yet, comparing the productivity gains between TR and ST (17.1% vs 14.3% increase), it appears that another important factor mitigating the implicit costs of redistribution is the meaningfulness of taxation. If tax revenues are used to support those in need, the implicit costs of redistribution are lower. We observe that high talent taxpayers are less sensitive towards variations in the cause of redistribution, while low talent taxpayers perform the best if the transfer supports needy peers. Looking at the results of the tax aversion literature (Kessler and Norton, 2016), one can suggest that it is the lack of meaning and justification for redistribution system, which may have lead to decreased performance and was interpreted as tax aversion.

Finally, receiving transfers yields the predicted positive effect: the work speed of disadvantaged players increases significantly with the effect being particularly strong for less able players. Thus within the redistribution system, the expected transfer motivates those who need it the most to enhance performance

The results of our experiments imply that the redistribution itself and especially redistribution supporting needy peers does not need to lead to inefficiencies. It may lead to higher productivity among taxpayers, who exert more effort to reach their income target and may support disadvantaged members of the society, thus leading to more people participating in production and to more production within the society as a whole.

Although the results of the laboratory experiments can not be translated directly into economic policy since there are many other factors affecting the implicit costs of redistribution (e.g., transaction costs, bureaucratic inefficiencies, leaky bucket effect, etc.) – we can see that the redistribution system has a potential be a powerful and undervalued tool to boost the welfare of the society with the help of meaningful and, therefore, accepted redistribution among its members.

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A Appendix

A.1 Instructions: TR treatment

Instructions

General rules for participants

You are now going to participate in an economic experiment. At the end of the experiment you will receive a payment. How much you will earn depends on your activities and partly on the activities of other participants. Therefore, it is important that you read the following explanations carefully.

Please do not talk to each other after the start of the experiment. Please do not try to communicate in any other way, unless you are directly asked to during the experiment. If you have any questions, please let us know by a hand sign. An experimenter will come to you to answer your questions. Not following these rules will lead to the exclusion from the experiment and from all payments. Your decisions in the experiment and your answers in the following questionnaire are **anonymous**. Your identity is revealed only to the experimenter, but your answers can not be matched to your identity.

The experiment consists of **three** parts. **You will first receive the instructions for part one of the experiment.** The instructions for parts two and three will be distributed after completion of the first part.

For the duration of the experiment you are randomly assigned by the computer to a group of two players. Apart from you, your group has one more person. **In all three parts of the experiment you are together with the same person in a group.** In each group, there is a person A and person B. The computer assigns the roles randomly at the beginning of the experiment. The decisions of the other person in your group may have an effect on how much you earn. The decisions of people who are not in your group definitely have no influence on how much you earn.

After completing all three parts of the experiment, your payment for all three parts will be summed up and displayed on the screen in Euro. It will be paid in cash at the end of the experiment. After completing the experiment, please stay in your cubicle until we start paying off. During the payment procedure, please wait in your cabin until you are called to collect your payment individually. No other participant will see how much you have earned. Please bring along all the materials you have received from us to the payment.

Before we start the experiment, we kindly ask you to seal your mobile phone in the envelope with your cubicle number. We will collect the envelopes and will return them back together with your payment at the end of the experiment.

Part 1

In this part, you and the other person in your group can individually solve math problems. You have **30 minutes**. Your income in this part is completely independent of the other participant in your group and depends on how many tasks you solve correctly. The same applies to the other person in your group: The other person's income depends solely on the number of the tasks she will solve correctly and is independent of the number of tasks that you will solve. The tasks which you can solve are addition and subtraction calculations with two three-digit numbers. In subtraction tasks the result can never be negative. If you solve the task correctly, pressing the "Next" button will bring you to the next task. **Please do not use pocket calculators or similar tools.** You and the other person solve the same calculation tasks in the same order. **For each correctly solved task you get 0.05 Euro.**

If you have any questions, please show it with a hand sign.

Part 2

In this part of the experiment you can again individually solve computing tasks. You have **30 minutes**. If you solved the task correctly, then pressing the “Next” button will bring you to the next task. **Please do not use pocket calculators or similar tools.**

The tasks which you can solve are addition and subtraction calculations. However, Person A will add or subtract two three-digit numbers and Person B will add or subtract two five-digit numbers. Reminder: At the beginning of the experiment, the computer randomly assigned one participant in the group to be Person A and another participant to be Person B. The number of solved tasks in part 1 had no effect on this. **For each correctly solved task, you receive 0.05 Euro, regardless of whether it is three or five-digit numbers.**

At the end of Part 2, Person A must give away 30% of her earned income. This means that person A's income from Part 2 is 70% of the income from correctly solved tasks. The rest is transferred to Person B and increases the likelihood that she will be able to participate in Part 3 (more details below). That means that as income from Part 2 Person B receives, in addition to her earned income, 30% of the properly solved tasks of Person A.

Part 3

All participants who got more than € 3.20 in Part 2 can participate in Part 3 of the experiment. This means that person A (without the sum transferred to person B) must earn at least € 3.20 in Part 2 in order to participate in Part 3. For person B, this means: if the income from her solved tasks and the transfer payment received from person A together amounts to at least 3.20 Euro, person B can participate in Part 3. If a participant does not participate in Part 3, she must nevertheless stay in the laboratory until the end of Part 3. In Part 3, you can again individually solve calculation tasks. You have **30 minutes**. The tasks you can solve are addition and subtraction calculations of two three-digit numbers (both for Person A and Person B). In subtraction tasks the result can never be negative. If you solve the task correctly, pressing the “Next” button will bring you to the next task. **Please do not use pocket calculators or similar tools.** If both players in the pair participate, they get the same calculation tasks in the same order. **For each correctly solved task, you get 0.10 Euro.**

If you have any questions, please show it with a hand sign.

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