Inequality of Opportunity and Investment Choices

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Abstract

Inequality of opportunity leads to misallocation of human capital and can affect economies via its impact on individual economic decision making. This paper studies the impact of inequality of opportunity on investment, using a laboratory experiment. We randomized inequality of opportunity, then subjects chose to invest in a risky asset or savings. Our results suggest that inequality of opportunity impacts investment choices only for people who are penalized by their circumstances and only once they learn the impact of inequality of opportunity on their relative position in the income distribution. This disadvantaged group invests more often and invests higher shares of their earnings than the control and advantaged groups. The fact that both inequality of opportunity and knowledge of relative position need to be present, for the impact on investment to materialize, points to the importance of peer effects. More broadly, this paper highlights the relevance of social preferences for understanding the effects of inequality of opportunity on individual decision making.

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1. Introduction

Inequality and growth interact in complex ways. The literature has not yet reached a full consensus on whether inequality has a detrimental impact on economic growth. On one hand, theory posits that inequality may boost growth by providing incentives when it rewards effort or when a larger share of income accruing to the rich increases aggregate savings. However, inequality can also hinder growth by misallocating talent and reducing accumulation of human capital. Empirical evidence is also mixed. Recent work (Ferreira et al. 2014, Brock 2020, Marrero and Rodríguez 2013) has focused on assessing the impact of inequality on growth by explicitly considering Inequality of Opportunity (IOp). IOp is defined as the portion of income inequality that is due to circumstances out of the individual's control, such as gender or place of birth, and different from inequality due to individuals' efforts and choices (Roemer 1998). The evidence from this recent empirical work is inconclusive and inequality, even in its form of IOp, cannot be definitively associated to lower subsequent growth.

In this paper, we focus on a specific channel through which IOp can impact growth: individual decisions about financial risk taking. If individuals exposed to inequality of opportunity reduce their exposure to risk in the allocation of their savings, overall investment may be constrained and, in turn, economic growth may be reduced. But the reverse may also happen. Research shows that people in disadvantaged circumstances at birth have lower lifetime income and wealth, and those with low socio-economic status allocate money to investment less often (Seto and Bogan 2013, Kuhnen and Miu 2017).[1] It has also been shown that people who experience loss from exogenous sources may behave conservatively when it comes to their financial choices. For example, experiencing economic downturns may cause individuals to have lower stock market participation (Bucciol and Zarri 2013, Malmendier and Nagel 2011, Bernile et al. 2017). But the generalizability of this pattern, and the mechanisms behind it, are not yet clear. For example, it is reasoned that the loss experienced from exogenous shocks make people more sensitive to downside risk (Knüpfer et al. 2017, Chakraborty 2004). At the same time, the literature tells us that financial risk taking is susceptible to peer effects, and that inequality between peers informs risky decision making (Bursztyn et al. 2014). Therefore, it may not only

[1] Bourguignon et al. (2007) models how IOp results from both the direct impact of unequal circumstances, but also indirectly through the circumstance-informed choices people make.

matter whether inputs of the income generating process are out of one's control (i.e. exogenous shocks and circumstances), but the relative distribution of outcomes among peers may also be important. Understanding this complexity is crucial for appropriate policy response to IOp.

We use a laboratory experiment to identify the causal impact of IOp on financial risk taking, paying particular attention to the role of peers effects (also known as consumption externalities). The outcome of interest is how subjects respond to a standard Gneezy and Potters (1997) investment choice.[2] For the treatment, the money subjects use to invest is first determined by IOp. We create IOp in the lab by randomizing whether earnings from a real-effort task were based on effort alone, or if they were also impacted by the zip code where the subjects spent the first 12 years of their lives (following the methods used in Durante et al. (2014)).[3] To reduce impacts from unobservables that are correlated with both zip code and propensity to take financial risk, we randomized whether each zip code led to higher or lower laboratory wages (i.e. a zip code that, in real life, is associated with relatively high incomes or high exposure to risky investment is, in the laboratory, randomly remunerated with a high or low wage). This gives three groups with respect to how subjects experience inequality: inequality arising only from effort (no IOp); inequality arising from effort and by advantageous zip code (IOp+); and inequality from effort and disadvantageous zip code (IOp-).

To test the hypothesis that peer effects determine the direction of the relationship between IOp and investment, we cross-randomized an information treatment where subjects learned their position in the earnings distribution by telling them their actual income rank. Since IOp puts people in rank positions that conflict with what they deserve according to effort, it is reasonable to consider rank position as an important input into subsequent decision making. In real life, individuals can at least partially observe consumption relative to peers. Therefore, to capture

[2]We use the terms "investment" and "financial risk taking" both to refer to the choice to allocate savings to an activity that may or may not yield returns, as in the stylized laboratory task. This is similar to a firm that wants to increase its capital stock to expand its production activity, or a saver who decides whether to allocate their money towards an investment that presents risks, or towards a riskless investment (in other words keep their earnings). For macroeconomists, investment represents the increase of capital stock and it is done by firms. This investment must be equal to saving that, in turn is the sum of household saving, government saving and foreign saving. Then financial intermediation, usually done by the bank/financial sector, matches investment and saving. In our setting, there are no firms and there is no intermediation by banks, and our subjects decide on their saving portfolio composition. This is equivalent to making the investment or not making it. Or one could think of our lab subjects as firm owners that are making this "fictitious" investment.

[3]The early IOp literature focuses on place of birth as the operative circumstance, while later work finds that being born in a place is not as meaningful as living there in one's youth. We therefore focus on place of residence during the majority of respondents' primary and secondary education.

effects from peer comparisons, we randomly reveal rank position to half of subjects. Crossing these two groups, one with rank information and one without, with the three groups that either did or did not experience IOp, provides six groups across which to compare outcomes. Comparing investment decisions between IOP and no-IOp groups provides the marginal impact of inequality of opportunity, compared to inequality from efforts. Comparing decisions between IOp+, IOp- and the control group reveals a true measure of heterogeneous treatment effects from IOp. Finally, examining these comparisons by whether subjects received rank information provides evidence on how peer comparison mediates responses to IOp.

Canonical models suggest that IOp would reduce investments. These models characterize the decision to take financial risk as a function of expected returns and risk aversion, where expected returns may be subjective. In this setting, IOp could have an impact through either of these variables. The literature on exogenous events and investment implies that IOp might act on subjective expected returns. Specifically, people who experience a lower income due to circumstances beyond their control may form pessimistic beliefs about the outcome of risky lotteries, and thus reduce financial risk taking (Kuhnen and Miu 2017). If we allow for malleability of risk preferences, by the same logic exogenous shocks could make people permanently more risk averse. In that case, we would again expect IOp to lead to less financial risk taking. Rank information is required to observe either of these effects.

Stepping away from the canonical model, IOp could actually increase financial investments. We know that when there is inequality in either outcomes or chances, people exhibit preferences over relative outcomes and over fairness of the income generating process (Cappelen et al. 2013, 2007, Brock et al. 2013). Low rank position has specifically been shown to motivate people to take more risk, in order to achieve their deserved, or expected, rank position (Bursztyn et al. 2014, Mollerstrom et al. 2015, Fliessbach et al. 2007). This phenomena of "keeping up with the Joneses" has been documented in both laboratory and non-laboratory settings (Bursztyn et al. 2014, Fafchamps et al. 2015, Luttmer 2005, Hopkins and Kornienko 2004). The quintessential example is that of investment bankers taking more risk when they fear they are falling behind peers (Brown et al. 1996, 2001).[4]

[4]Beyond income levels, perceptions about relative positions or rank play a role in the literature of pay transparency and demand of redistribution. For example, Card et al. (2012) find that pay transparency increases turnover, due to lower job satisfaction among those with below median salary (with no apparent increase in job satisfaction for those that earn more than median). Cruces et al. (2013) highlights rank perceptions as a major determinant

Finally, we explore heterogeneous effects by (exogenous) circumstance group (i.e. socioeconomic status at birth). Heterogeneous effects by socioeconomic status are ubiquitous and important, but rarely is this status randomized. In our work, we randomize status by allocating subjects' childhood zip code to being of either high or low economic value. Subjects with low value zip codes will, by construction, have a lower income rank than they deserve, based on their efforts. They may thus be more likely to risk earnings than the high value zip code peers, to recover "lost earnings". On the other hand, if these subjects feel discouraged by their misfortune, and pessimistic about future outcomes, their risk taking will be lower.

The lab is well suited for this topic of study because, in the real world, other forms of inequality often co-occur with IOp, and possibly have similar determinants. Two pertinent examples are unequal access to finance and differential rates of return on investment. Access to investment opportunities correlates with wages, through education, upbringing and ambition (Benabou and Tirole 2006). By the same token, rates of return often differ – low income people play the lottery while high income people buy stocks (Beckert and Lutter 2013). Both are risky investments, but one has a much higher probability of gains. Thus, outside of the laboratory, it is difficult to separate out the causal impact of the IOp.

The findings of the paper bring new insights into the mechanisms linking IOp and investment choices. We find that IOp does not, on its own, impact investment behavior. Instead, knowledge of one's income rank is necessary to transmit the experience of inequality of opportunity to investment decisions. When IOp is accompanied by rank information, the disadvantaged group (from zip codes allocated to the lower earnings rate) tends to invest more than the advantaged group. There are two main upshots. First, the burden of IOp, in terms of risk taking, falls on the group who is comparatively worse off. This group appears to use the investment opportunity to catch up to higher ranked peers, but may also be least able to afford the downside risk. Second, this means that we can learn more about the impact of real world economic shocks on investment by including considerations of heterogeneity, peer effects and, perhaps, social preferences more broadly.

Our work also brings new clarity to the experimental literature on inequality and risk taking,

of redistribution policy. In a survey experiment, they find that those who overestimated their income ranking demanded more redistribution when provided with accurate information. So, we will also elicit and report impacts from rank preference distortions.

showing that the motivating power of peer comparison for risk taking may be unique to settings where income inequality has an exogenous component. We do this by including a control group where inequality is determined exclusively from effort.

The paper proceeds as follows. Section 2 describes our contribution to the literature. The experimental design appears in Section 3. Section 4 presents and discusses results and is followed by the conclusion.

2. Contribution to the literature

The established literature on the relationship between income inequality and investment is largely theoretical and/or correlational, and does not extend to IOp (Aghion et al. 1999, Banerjee and Newman 1993, Banerjee 2004, Barro 2000). It focuses on constraints posed by unequal access to finance, rather than determinants of financial risk taking. The foundational assumption is that the marginal propensity to save is higher for the rich than the poor, hence inequality is positively correlated with investment. This theoretical correlation has been challenged. Galor and Moav (2004) point out that this makes sense when growth relies on physical capital accumulation, but less applicable when it relies on human capital. And since opportunities to invest differ between wealthy and poor, their investment in human versus physical capital may differ (Banerjee and Newman 1993, Demirgüç-Kunt and Levine 2009).[5] In this paper, we look at the implications of inequality in the income generating process rather than inequality in access to credit. Moreover, with the notable exception of Bourguignon (1981), papers in this literature tend to abstract away from individual decision-making.[6]

Empirical studies aiming to link IOp and investment typically look at differential stock market participation of advantaged and disadvantaged groups. Stock market participation is increasing in income and education (Seto and Bogan 2013), and tends to be lower among women and minorities (Choudhury 2002). While suggestive, this literature is not definitive about the impact of inequality of opportunity on investment because it cannot rule out confounding fac-

[5] Advancements in this literature include accounting for heterogeneity in wealth and imperfect credit markets.

[6] Our paper is also related to Alesina and Perotti (1996), which studies the political stability channel through which inequality affects investment. Inequality increases social discontent and fuels social unrest, which has a negative effect on investment due to increasing social and political uncertainty. If gains and losses are unearned, it can also increase uncertainty about future gains and losses. But our work diverges from this by eliminating uncertainty. Indeed, uncertainty is not inherent in inequality of opportunity. But we acknowledge that uncertainty and IOp would be an important area for future research.

tors. For example, income, wealth and education tend to be influenced by initial circumstances (Ferreira and Gignoux 2014, Brock 2020). Our paper improves upon this literature by holding access to investment and interest rates equal across groups, and isolating the impact of the unfair inequality separate from the other ways in which exogenous shocks impact other aspects of life.

Our experimental design is informed by two strands in the experimental economics literature. The first examines investing when the income of a partner/peer is higher or lower than one's own. The consensus is that people will take more risk to avoid having less income than a peer (Linde and Sonnemans 2012, Lindskog et al. 2022, Gamba et al. 2017). The result extends to how incentives are structured, with rank incentives increasing risk taking as much as tournament incentives (Kirchler et al. 2018). With the exception of (Kirchler et al. 2018), these papers evaluate behavior of pairs of subjects, such that income inequality is defined relative to one other person. Fafchamps et al. (2015) take this one step further by analyzing behavior across multiple rounds in six people groups. Between rounds, they provide information to all participants on the earnings of all group members. Consistent with the literature, they find that low endowment subjects risk higher shares of income than high endowment subjects, on average (controlling for past winnings). Since the concern is to precisely describe how subjects react to having less (or more) than a peer, they do not consider scenarios where rank is not precisely known. This literature informs our work by showing the importance of rank on risky decision making. It thus paves the way for us to consider this rank-risk relationship as the operative link between IOp and risk taking.

More fundamentally, our paper uniquely compares the impact of this rank information across income generating processes. In other words, we include a control group where subjects are not exposed to randomness in the income generating process. In real life, the counterfactual of good luck is not necessarily bad luck. Ideally these studies would include a comparison group where everything is the same, except the exposure to random luck in the income generating process. Including a suitable comparison group, or control, is particularly important in studying inequality and peer comparison since the literature shows people respond differently to different income generating processes.

The second strand of experimental literature to which we contribute examines how IOp impacts preferences for redistribution (Krawczyk 2010, Brock et al. 2013, Akbaş et al. 2019,

Mollerstrom et al. 2015, Durante et al. 2014). The papers in this literature that explicitly look at risk preferences examine how risk in the income generating process impacts subsequent non-risky decisions. They do not look at risk as the decision of interest (Cappelen et al. 2013, Akbaş et al. 2019). The consensus is that inequality from exogenous income differences increases preferences for redistribution. This relationship appears to be due to people's preferences for increasing ex post equality when ex ante chances are not equal or "fair". Fair is typically defined as income being based on choices or effort. Durante et al. (2014) is the most explicit about examining IOp, defined according to Roemer, as in our paper. And it is Durante et al. (2014) that most influences our design: we adopt their use of zip code to simulate IOp in the lab, and compare it with other kinds of income generating processes as they do. Our paper builds on Durante et al. (2014) in applying these techniques to focus on investment.

Finally, our work directly builds on a recent experimental study by Hillebrandt and Steinorth (2020). In their study, they compare investment choices between subjects who receive information about others' wealth endowments, to a control that does not receive information. Endowment itself is held constant. Revealing other's endowments makes poorer subjects take more risk and richer subjects take less risk. Unlike their paper, we use earned income, rather than wealth bequest. We also do not reveal actual wealth/income, and instead only share rank information. This eliminates any counteracting effects from earning level itself. Finally, we also use an exogenous circumstance as the determinant of inequality in the treatment group. This gives us a direct link to the theory on inequality of opportunity.

3. Experimental design

With the experiment, we aim to answer two primary research questions: (1) What is the marginal impact of IOp on individual investment in a risky asset? (2) How does earnings rank interact with the source of inequality in the income generating process to impact investment decisions?

We conducted our laboratory experiment between February 2020 and July 2021 at the University of Maryland Department of Agricultural and Resource Economics - Symons Hall Experimental Laboratory (SHEL). There were a total of 499 subjects, out of which 240 completed

11 in-person sessions.[7] Due to the COVID-19 pandemic, the remaining 259 observations were collected using the online platform nodeGame.[8] Subjects earned tokens, which were converted to US dollars in the ratio 50 tokens to $1 USD.

The experiment consisted of three rounds. In Rounds 1 and 2, subjects completed risk preference elicitation activities and a real effort task, respectively. The treatment was administered between Rounds 2 and 3. For Round 3, we gave subjects a second round of earnings from the real effort task, but this time half of the subjects had earnings based on effort alone (same as Round 2) and the other half received earnings determined by both effort and zip code at birth. Before the final round, subjects reported their perceived income rank. Half were then told their actual rank. Round 3 was the investment game. The basic design is outlined in Table 1. We now describe each round and the treatment in more detail.

Round 1

The risk preference elicitation tasks in Round 1 were Eckel and Grossman style tasks. For each, subjects chose a preferred prospect from a collection of risky prospects. Each prospect entailed different high and low pay-outs, with a 50% chance to win either pay-out. For the first task, all high and low pay-outs were positive. In the second task, the low pay-out for some prospects was negative, such that subjects could lose tokens with a 50% probability.[9]

Round 2

In Round 2, subjects completed a computerized ball catching task (Gächter et al. 2016). In this task, subjects moved a basket across the bottom of the screen to catch balls that fell from the top of the screen. Catching a ball was worth 20 tokens, while clicking the mouse to move the basket one step over cost 10 tokens. Total earnings was equal to the balls caught times the earnings per ball, minus the number of clicks times the cost per click. The task involved 6 periods, with the first three periods used for practice. Each task period lasted one minute. Clicks and catches in each task period were displayed at the top of the computer screen (Figure 1).

The real-effort task serves three purposes. First, we needed to generate an endogenous distribution of earnings. Second, we wanted to elicit perceptions of lab-specific effort (in terms

[7]Power calculations indicate that a total sample size of 500 is required to achieve 80% power.

[8]Results are not sensitive to whether the experiment was completed in the laboratory or online, though the drop in power from smaller sub-samples does reduce significance.

[9]We use the measures of risk aversion and loss aversion from these tasks to explore treatment effect heterogeneity. We do not find evidence of such effects. Results are available upon request.

of number of clicks) and income ranks, prior to the treatment. Lastly, we wanted to ensure that earnings given at the start of Round 3 did not include priming effects from zip-code based IOp.

IOp treatment

After completing Round 2 and answering questions about perceived effort and income rank, we informed subjects that they would face an investment opportunity and would get a pot of tokens to use for this purpose (or to keep if they preferred not to invest anything). The pot of tokens was based on their performance in the ball catching task, but the source of earnings inequality differed between treatment and control. In the control group, all subjects earned 22 tokens per ball caught (a raise compared to Round 2). There was otherwise no change in how total earnings were calculated. Thus, in the control group, earnings inequality was based solely on the work the subjects did and the choices they made for how to complete the ball catching task.

In the IOp (treatment) group, earnings per ball caught were based on the work done in Round 2, as well as the zip code where they spent the first 12 years of their life.[10] Each zip code was randomly assigned to earn either 27 tokens per ball caught (IOp+) or earn the same as the control group, i.e. 22 per ball caught (IOp-). Finally, we enhance external validity by contextualising this randomization: we tell subjects that sometimes people get less in life due to factors outside of their control, and that the difference in earnings potential for the Round 3 pot of tokens is based on their childhood zip code. Thus, the inequality in this group is based on both efforts and IOp. In this way we randomize people into different sources of inequality at the beginning of Round 3 (for a similar approach, see Durante et al. (2014)).

Subjects knew the possible earnings levels in their group. Control group subjects knew that everyone was making 22 tokens per ball caught.[11] Treatment group subjects knew that there was earnings disparity and they also knew that it was due to randomization of zip code into high and low value (IOp+ and IOp-). Note that the control group and people in IOp- got the same rate of earnings, so we can directly compare these two groups, with the only difference between them being the relative meaning of that wage. Comparisons between IOp+ and IOp- groups tell

[10]Wording of the question was: Please enter the postal code of the place you lived for the first 12 years of your life. If you moved, enter the post code where you spent the most time. If you lived abroad, specify "International" in the drop down menu and type in the city and postal code

[11]They did not know that there was another group where earring rates were different.

us the marginal impact of the wage differential, given IOp. Comparing the IOp+ group to the control groups gives the combined effect of IOp with being in the advantaged group.

We chose not to introduce different rates of earning in the control group because it would compromise our ability to cleanly identify the marginal impact of IOp. For example, we could have randomly allocated people into high and low wage groups, with no IOp contextualisation, but this would not have been completely context free. It would have, instead, been random luck. The comparison between treatment and control would then tell us the marginal impact of IOp compared to random luck, rather than just the marginal impact of IOp. Another option was to give the highest performing subjects in the control group a wage increase, equal to the high value zip code group. This would have invoked and relied on beliefs about fairness and would have entailed an arbitrary decision on how to measure performance (e.g. total number of catches or efficiency, of catches per click). It would have also introduced too many variables into the experiment, and thus compromised the aim to measure to marginal impact of IOp. Thus, in order to retain an "effort vs circumstances" comparison, we did not include wage inequality in the control group.

Rank information treatment

After telling subjects their updated earning rate, we again asked them to estimate their income rank. This captures any changes in rank perception due to the updated earnings information. We then administered the information treatment. Two-thirds of the subjects were told their true rank. One-third of the subjects received no rank information. No subjects learned their actual income.

The 2/3 to 1/3 split was to ensure that there were enough subjects receiving "bad news" (that their rank is lower than they expected) to use it in analysis; since the direction of the news is endogenous, we could not determine cell sizes definitively ex ante, but past research and the pilot suggest the 2/3 to 1/3 split to be adequate. Randomization of rank information was crossed with assignment to the IOp treatment, to ensure that half of people in each of IOp and Control received the rank information.

Round 3

In Round 3, subjects were asked if they wanted to invest the tokens in a risky investment, which yielded a return of 2.5 times the principal with a probability of 1/3, or a total loss of all the principal with a probability of 2/3. They had the option to invest none, a portion or all of

their tokens. After the investment choice and learning the outcome from their investment, we again asked subjects their perceived income rank. All subjects then learned their final earnings quintile.

The experiment concluded with a non-incentivized survey. We asked subjects about demographic variables, their opinion about the experiment, what strategies they used for the ball-catching task and how they feel about inequality. The full debriefing survey is in the Appendix. Each subject's final earnings were determined by their tokens earned in Round 1, as well as earnings from an additional randomly selected payment round (either Round 2 or Round 3). Subjects were paid in cash and in private at the end of each session.

4. Results

We first analyse the marginal impact of IOp on investment behavior, then discuss results from the rank information treatment. We present comparisons between the six randomized groups in the data: control with and without rank feedback, IOp+ and IOp- and rank feedback, IOp+ and IOp- and no rank feedback. Comparing behavior between control group subjects and those in the IOp- group provides the marginal impact of IOp. Within the IOp group, comparing low and high value zip code groups gives the marginal impact of zip code value. More generally, it is a comparison of how subjects allocated to an advantaged group behave differently from those allocated to a disadvantaged group.[12]

Figure 2 shows the average propensity to invest for each group. Figure 3 shows the average portion of the earnings that was invested. The gradient of the grey color for the bars is used to distinguish the source of inequality for the various groups: light grey identifies the no inequality of opportunity group, medium grey denotes IOp-, and dark grey denotes IOp+. The three bars on the left of each chart pertain to subjects who did not receive rank information. The three bars on the right pertain to subjects who did receive rank information.

Starting from Figure 2, the similarity in bar height among the three groups without rank feedback shows that there is limited direct impact of IOp on investment choices. Subjects in neither IOp+ nor IOp- are more or less likely to allocate non-zero amounts to the investment opportunity, compared to the control (two-sided Fisher exact test has $p = 1.00$). Conditional on

[12]Low and high value zip codes had no practical meaning in the control group (no IOp) group, since all subjects in that group had the same earning rate.

investing, subjects in IOp+ invest 10% more of their earnings than the control (see Figure 3). But this result is weak; it has wide confidence intervals, and is not statistically significant, or different from investment among subjects in IOp-. Mean investment proportion for subjects IOp- and IOp+ is 24.44 percent and 22.44 percent, respectively (t-test $p = 0.49$). Meanwhile, investment amount among subjects in IOp- is not statistically different from the control (t-test $p = 0.33$). Without the rank information, the source of inequality does not seem to matter for either the decision to participate in a risky investment or the amount allocated to such investment.

Consider now the rank information treatment, namely the three bars on the right side of each figure. These represent choices of people who are informed about their actual rank and, at the same time, exposed to different types of inequality. As shown in figure 3, subjects with low value zip codes (IOp-) invest significantly more than the control (t-test $p = 0.03$), and significantly more than subjects in IOp+ (t-test $p = 0.00$). In turn, subjects in IOp+ invest less than the control (t-test $p = 0.05$).[13] The result also holds if we control for the kind of information subjects received. Figure 2 shows that the same pattern exists for propensity to invest, but is insignificant.

In sum, results support a peer comparison mechanism rather than pessimistic subjective expectations about risk (following an exogenous negative shock). When precise income rank is unknown, IOp does not appear to have a direct impact on investment choices. This is backed up by the fact that, absent rank feedback, there is no difference between subjects with low value zip codes and the control. But IOp does impact investment when income rank is known. In particular, receiving this information spurs subjects in IOp- to take more risk than both the control (same wage, different context) and those in IOp+ (same context, different wage).

4.1. Feedback information content – Type of news and actual income rank

To better understand why rank information may trigger the observed effect, we analyse the content of feedback messages. Subjects received two connected pieces of content: their actual pre-investment income rank and, connected to this, confirmation of whether the subject had underestimated or overestimated their rank, or estimated it correctly. The analysis shows that

[13] Recall that this difference combines the wage difference (high vs low) and the source of the wage itself (IOp vs no IOp).

the piece of information about the rank matters, while getting positive or negative news (being told that one is richer or poorer than they thought) does not matter. More specifically, when individuals find out that they are in the lower part of the distribution (*and* this is happening when there is IOp), they invest more (vis-à-vis the control group with information) to catch up with their peers. As long as their actual rank is in the lower part of the distribution, investing more happens notwithstanding whether they are 'surprised' positively or negatively. A similar reasoning can be applied to people who find out that they are in the top part of the distribution. For these individuals, the information about being in the top ranks does not trigger any need to catching up with peers. In fact, these individuals invest a smaller proportion no matter whether they receive bad or good news. Using regression analysis, we consider these issues in more details in the next two subsections.

4.2. Actual income rank

Information about actual income rank mediates the impact of IOp on investment.[14] Column 1 of Table 3 shows that while there is a negligible correlation between income rank and investment without IOp, IOp introduces an incentive for low ranked people to invest larger portions of their income than similarly ranked people in the control group without IOp. The effect diminishes as income rank improves and switches sign for the top ranks. There is a similar pattern for propensity to invest a non-zero amount (top panel).[15]

To confirm that this result is due to knowing one's rank and not poor relative performance per se, we show results from the same regressions, but now partitioning by whether subjects did or did not receive rank feedback (Table 3, Columns 2 and 3). If the factors that determine rank (i.e. relative performance) motivate the results, then we would expect to see significant coefficients on the IOp term and the interaction term for both samples. If it is rank information, then we would only expect the result to emerge in the group that received rank information. Results indicate the latter is true. 1.8 percentage points for a 1 decile increase in income rank.

[14] In our pre-analysis plan, we hypothesized that perceived income rank would correlate with people's investment choices (in the control group), and that correcting misperceptions would impact that relationship. We further hypothesized that IOp would lead to larger errors in income rank perception and thus have a distortionary impact on investment through perceived income rank. We actually find no relationship between perceived income rank and investment choices, with or without IOp (Table A.4).

[15] Subjects generally understood their skill, in terms of how clicks and catches per click. The scatter in Figure 5 shows people's self report of their clicks against their catches/click ratio. Those with higher ratios reported a lower number of clicks.

The pattern emerges for those that do not get information, but the coefficient is less than half as large and not significant (compare Columns 2 and 3 in Table 3). Therefore, we conclude that knowing one's actual rank is what generates the impact from the IOp.

The patterns are consistent with peer effects. On a scale of 1 to 10, where 10 is the top rank, subjects in IOp- have a median perceived rank of 5 (mean is 5.35). For the corresponding subjects in IOp+, the median perceived rank is 7 (mean is 6.75). In reality, subjects in IOp- are more likely to occupy lower ranks. A share of 90% of subjects with low (high) value zip codes occupies rank positions lower (higher) than the midpoint of the rank ladder. Thus, when subjects in IOp- get the rank information, they learn that they are behind their peers in terms of earnings – importantly, they are not in the middle of the distribution. This motive is uniquely salient when there is IOp because the source of being behind is beyond their control. Indeed, information does not generate this impact in the control group, as being behind peers in this group is linked to the fair inequality arising from differences in efforts.

Figure 4 shows the investment pattern implicit in the coefficients of Column 3 of Table 3. When information about the rank is provided, individuals in the group exposed to IOp of ranks 1 to 6 invest more the corresponding individuals of the control group. This relationship switches sign for the top ranks (rank 7 to 10) where people exposed to IOp invest less than the control group.

4.3. Type of news

Information on actual income rank entails receiving one of three types of news: whether each subject guessed their income rank correctly, underestimated it or overestimated it. We find that the type of news received is not correlated with investment behavior. The mean treatment differences described are also robust to controlling for information type (see Appendix Table A.5). Finally, there are no heterogeneous impacts between those in IOp- and IOp+. We conclude that type of information received does not explain treatment effects.[16]

In summary, the impact of IOp on investment appears to be linked to knowing one's actual rank, rather than perceived rank or rank perception error. Neither knowing rank absent IOp, nor having IOp absent rank information, appears to influence investment choices, compared to the

[16]Since the type of information received is determined by the subjects' estimation error, we can also conclude that investment is not differently impacted by the propensity to over- or under-estimate rank.

control. The central role of rank information for the impact of IOp supports the hypothesis that IOp impacts investment through the channel of peer comparison.

4.4. Value of investment and gains to risk taking

Up to this point we considered the financial risk taking by individuals who differ in their exposure to different types of inequality and information. However, we can also aggregate these results and address these questions: does a society (simulated by our experiment) with IOp take more risks, and are these risks biased against the people with low zip codes and, at the end, would overall investment be higher in a society with IOp vis-à-vis one with no IOp?

Overall, there is more financial risk taking in an a context with IOp as the total amount of tokens invested was 17% higher in IOp group than the non-IOp group (difference in means is 20.32 with $p = 0.072$, Figure 6), with no difference in averages between groups with and without rank information. This may seem unexpected, since there is a large impact of rank information on shares invested for low value zip code subjects. But recall (and as shown in Figure 4) that high value zip code subjects decreased shares invested when given rank information. Thus, the decreased shares invested in one group offsets the increase in the other group. Figure 7 demonstrates that, when there is no rank information, the token value of investments is higher in IOp+ than IOp-. Once people get rank information, subjects IOp+ take less risk and those in IOp- take more. The upshot is that while the total tokens invested does not differ with and without IOp (or rank information), different groups are exposed to the risk.

5. Conclusion

In this paper, we use a laboratory experiment to explore the relationship between inequality of opportunity (IOp) and financial risk taking, in terms of both participating in a risky investment and the amount devoted to this investment. The laboratory setting allows us to isolate the impact of IOp itself from other confounding factors (correlates of IOp), such as educational attainment which may also affect risk taking. In addition, it also lets us discriminate between two possible mechanisms behind the relationship between IOp and risk taking. In addition, it also lets us discriminate between two possible mechanisms behind the relationship between IOp and risk taking.

One mechanism is that IOp may engender pessimistic beliefs about outcomes of risk and the other is that peer comparisons of relative positions in the income distribution. The pessimistic

beliefs mechanism comes from the literature on impacts of exogenous negative shocks, such as an economic depression. Results in this literature imply that experiences of loss stemming from exogenous circumstances reduce investments. The reasoning is that these experiences make people more sensitive to downside risk (Knüpfer et al. 2017). IOp can also be thought of as an exogenous shock, as it encapsulates the differential earning potential due to exogenous circumstances. Categorized this way, it may be reasonable to assume that being subject to IOp leads to pessimistic beliefs about investment outcomes and, in turn, to less financial risk taking. This outcome is not dependent on information about relative income positions but just on the knowledge that one belongs to a disadvantaged group.

The other mechanism is peer effects. People have utility over relative consumption. The literature suggests that, when rates of return are the same, information on relative consumption, including income rank, can impact risk taking. IOp directly affects income rank, making it less reflective of individuals' effort. People may respond to this differently, depending on whether they are relatively more or less well positioned as a result of the IOp. Those that are less well positioned would be expected to take more financial risk than better off peers in order to reach the rank they think they deserve. This pattern of results requires that subjects know their income rank.

We find evidence in favor of the peer effect mechanism. Knowing one's income rank is critical for determining the impact of IOp on investment choices. Rank information absent, there are no statistically significant effects of IOp on investment propensity or amount, compared to control. When the disadvantaged group learns that their rank is lower than what they expect based on their effort, they use the investment task as a way to recover the "lost" rank – they are trying to "keep up with the Joneses". Also, while the IOp treatment does change rank perceptions, these perceptions do not impact investment choices. Thus, people do not appear to be bothered by their perception of their place in the distribution, and instead use true information about income rank to inform their decision making.

While presence of peer effects does not preclude formation of pessimistic beliefs in theory, we do not find evidence of the latter in our experiment. How can we reconcile this with studies that find less financial risk taking after a disaster? There are a few possibilities. First, the laboratory provides a controlled environment, without feedback loops or interacting constraints that may be present in real world data. In other words, studies looking at impacts from large

negative shocks may be capturing a reduced form effect. Second, the laboratory subjects had restricted options – either invest or save. In the real world, people have many options for how to recover rank after a community level shock. One example is risk sharing with family and neighbors. Another may be spending money on physical assets, as a way to signal rank. Third, there may be a role for scale. The loss in the laboratory from receiving the bad outcome in the IOp lottery is relatively small, and people may respond differently when the shock is large. Nonetheless, by showing how IOp impacts investment in a controlled environment, we offer new insights that can advance research on financial decision making after exogenous shocks.

Distinguishing between inequality due to sources within one's control from those outside has policy implications in various areas because it helps overcome the view that there is a trade-off between efficiency and equity. For example, policies aiming at equalizing opportunities (affirmative action, redistribution, progressive taxation, among others) may also boost growth (Marrero and Rodríguez 2013, Hsieh et al. 2019, Cuberes and Teignier 2016). The distinction also matters for understanding people's attitudes towards redistribution (Durante et al. 2014, Cappelen et al. 2007) and thus helps improve the design of tax and transfer systems. This paper contributes to advance this equity cum growth agenda by focusing on the linkages between inequality and investment.

The literature has so far focused on institutional failures and poor financial literacy, which both limit access to investment options. However, the optimal policy response changes if inequality of opportunity matters for individual investment decisions, especially if the peer effect mechanism is operating and triggers people at the bottom of the distribution to assume additional financial risk, as our results have shown. Whether this is good or bad for individuals or the economy depends on the type of risky investments people make. This is where access considerations matter again. People from privileged backgrounds may have access to investment opportunities that are different from those available to others. For example, low wage, low rank people may not be able to respond to rank information with productive investments. They might instead engage in gambling or playing the lottery. On the other hand, exogenously low ranked individuals may respond by investing in human capital, instead of financial capital. For example, migrant populations often find themselves low ranked in the host countries and tend to invest heavily in their children's education (Dustmann and Glitz 2011). Future work can look at how IOp changes trade-offs between different kinds of investment options.

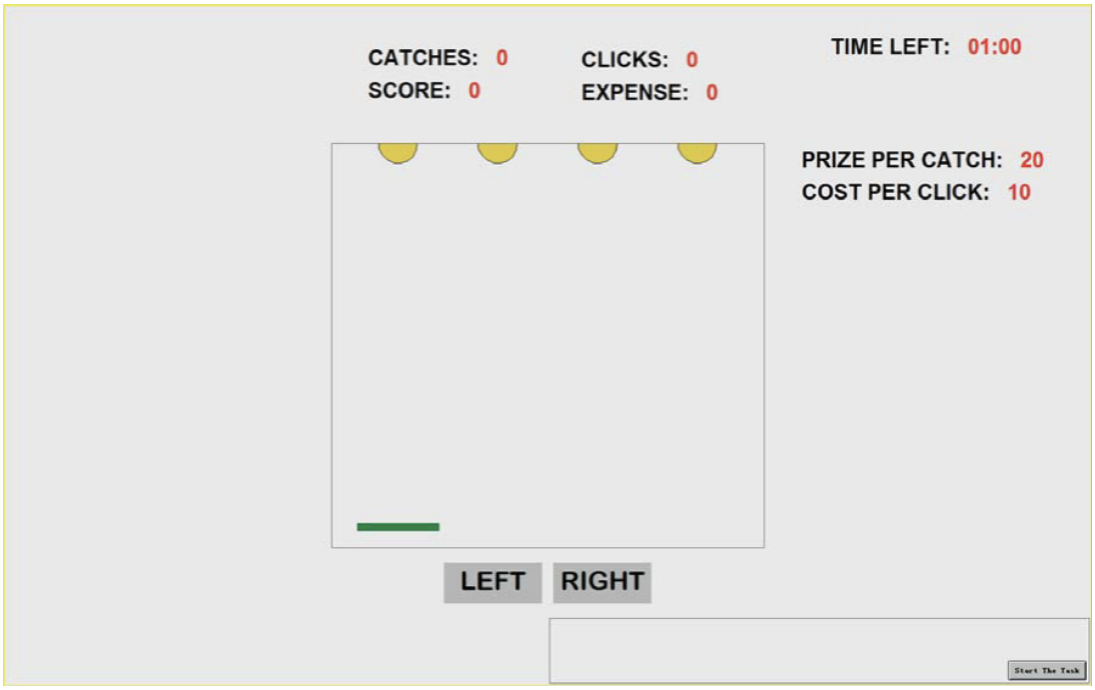
Finally, we set an agenda for future research on IOp and investment, by bringing together results on exogenous shocks to income generation with results that focus on socially motivated decision making. No decision-maker maximizes their own welfare in isolation from others. What we buy, how much we save, how we invest, how we expect to retire, how poor or rich we perceive ourselves – all are informed by comparison with people around us (Mugerman et al. 2014, Moretti 2011). Therefore, not just inequality itself, but how one experiences inequality is likely to be an important input into economic decisions. These insights have yet to be fully incorporated into the way we think about the impact of IOp on outcomes. Our paper takes a step in the direction of doing so, with a focus on investment choices and it is unique in how it traces the causal chain between IOp and actions, through the mechanism of peer comparison.

6. Tables and Figures

Table 1: Randomization of IOp and Rank information

Treatment	Source of income inequality	Income rank provided
Control	effort only	no
IOp only	effort + circumstances	no
Control w/ info	effort only	yes
IOp w/ info	effort + circumstances	yes

Figure 1: Screenshot of the real effort task



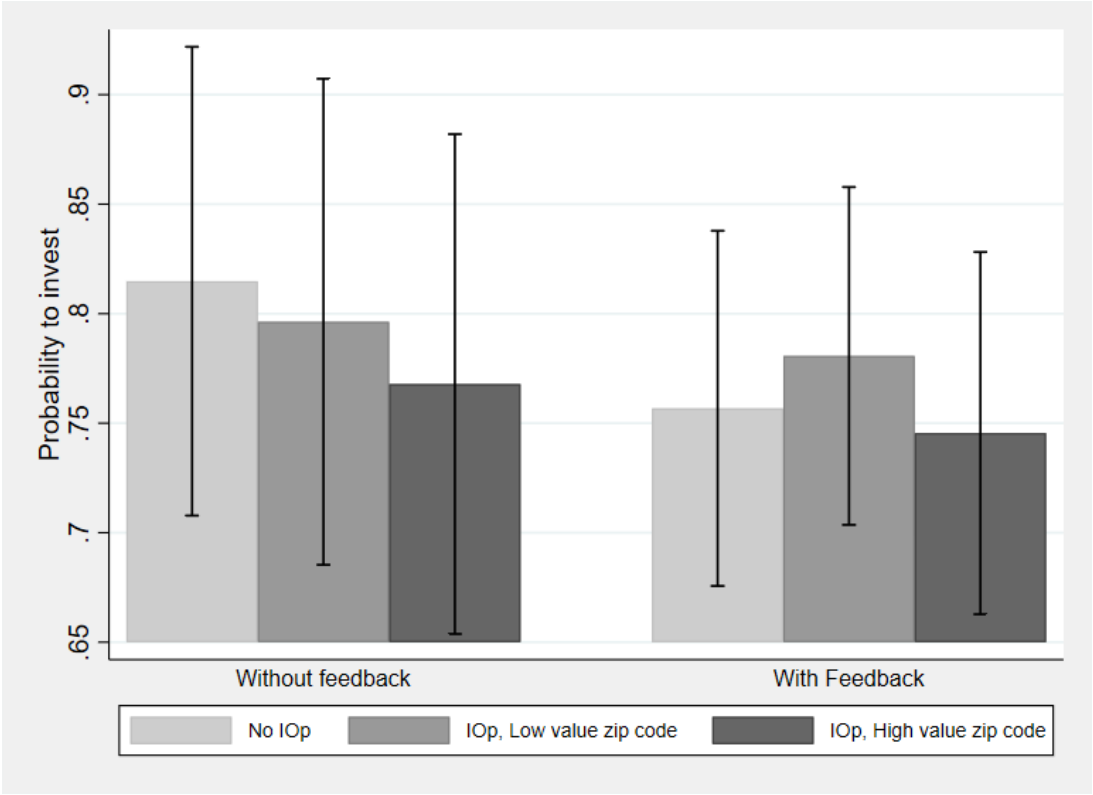
Note: Task design is from Gächter et al. (2016). The object of the task is to "catch" the yellow balls with the green bar, as the balls fall from the top of the screen. Subjects click the "LEFT" and "RIGHT" buttons to position the green bar and make a catch.

Table 2: Mean outcomes by treatment group

Treatment group	N	Propensity to invest	Portion invested	Tokens invested	Total take home amount
Control	54	0.81	0.20	117.38	676.69
IOp, high value zip code	56	0.77	0.22	160.67	875.64
IOp, low value zip code	54	0.80	0.24	125.93	643.05
Control w/ info	111	0.76	0.23	121.12	680.48
IOp w/ info, high value zip code	110	0.75	0.18	119.64	866.35
IOp w/ info, low value zip code	114	0.78	0.29	156.79	655.26

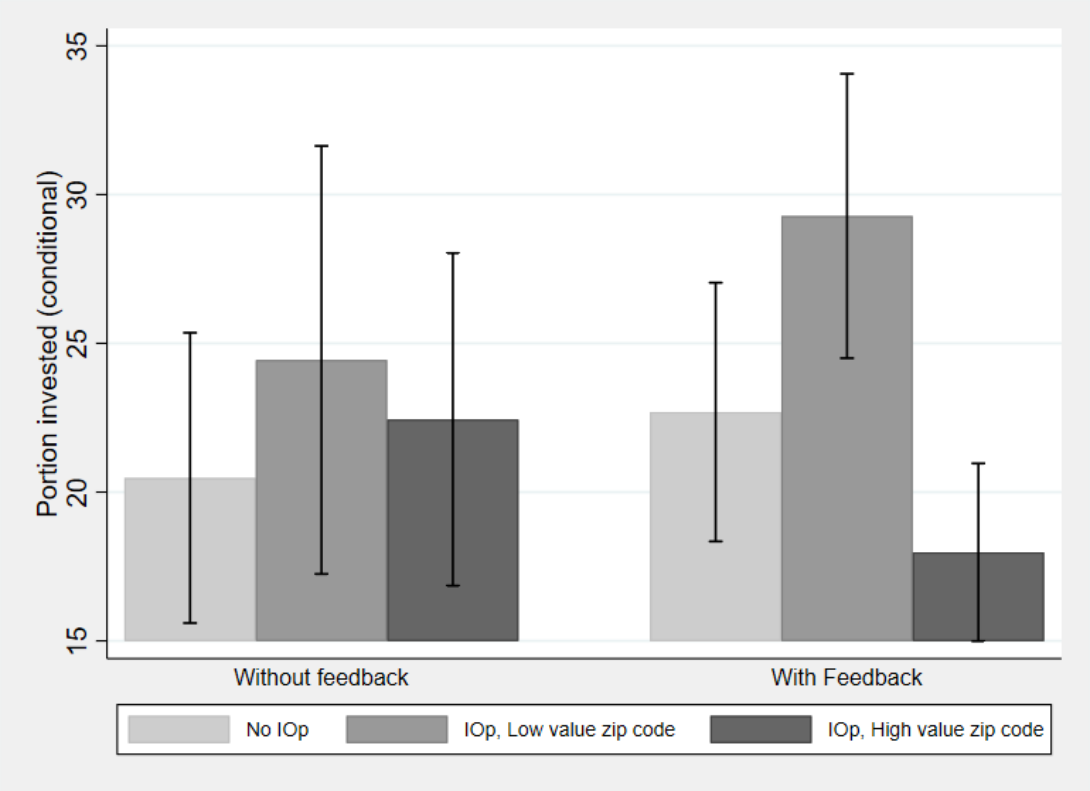
Note: Each zip code was randomized to high or low earnings per click, within the IOp treatment group. In the control group, there was no randomization of zip codes.

Figure 2: Mean probability of investment, by treatment group



Note: Bars indicate means and capped lines indicate standard errors.

Figure 3: Mean portion of earnings invested (conditional on investment > 0), by treatment group



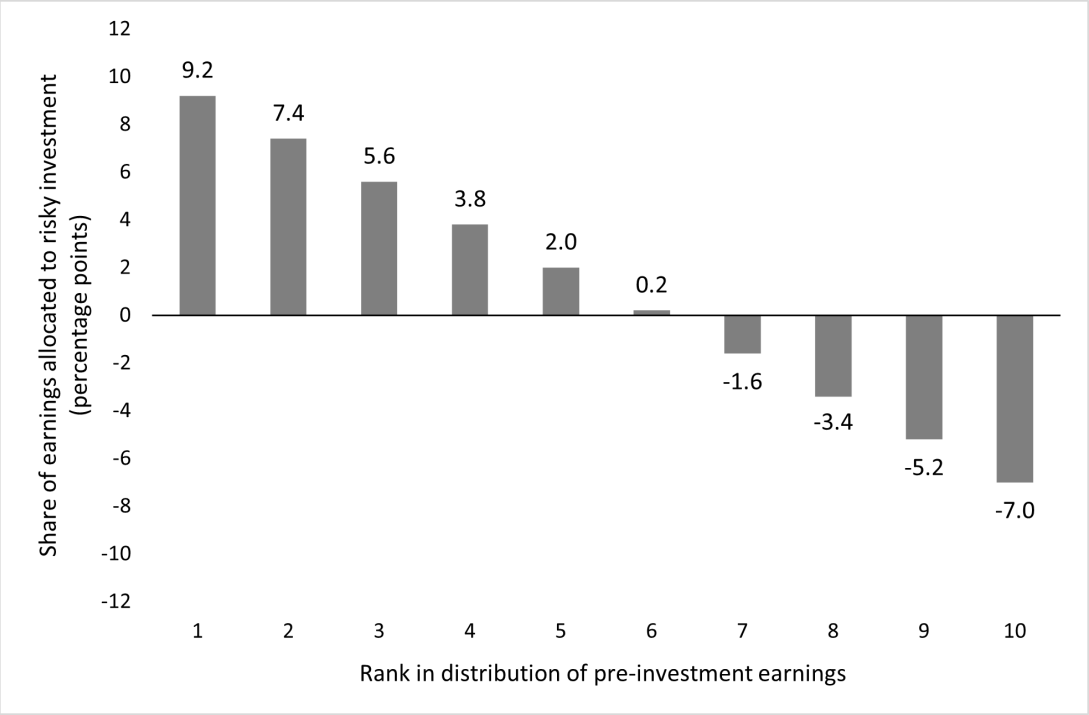
Note: Bars indicate means and capped lines indicate standard errors.

Table 3: Impact of IOp on investment behavior depends on Earnings Rank

	(1)	(2)	(3)
Dep var: Binary = 1 if subject chooses to invest			
	All	Without rank feedback	With rank feedback
Pre-investment earnings rank	0.0337	-0.0161	0.0528
	[0.618]	[0.912]	[0.488]
IOp treatment	0.427	-0.0206	0.612
	[0.362]	[0.983]	[0.249]
IOp X Pre-investment rank	-0.0827	-0.0288	-0.104
	[0.284]	[0.861]	[0.231]
Constant	1.066***	1.564*	0.859*
	[0.00630]	[0.0609]	[0.0536]
Observations	499	164	335
Pseudo R-squared	0.006	0.004	0.014
Dep var: Portion of earnings invested, conditional on being > 0			
	All	Without rank feedback	With rank feedback
Pre-investment earnings rank	0.512	0.838	0.361
	-[0.345]	[0.471]	[0.550]
IOp treatment	9.419**	4.188	11.00**
	[0.0182]	[0.612]	[0.0171]
IOp X Pre-investment rank	-1.384**	-0.307	-1.771**
	[0.0449]	[0.841]	[0.0195]
Constant	19.19***	16.23***	20.71***
	[0.000]	[0.006]	[8.80e-10]
Observations	385	130	255
R-squared	0.019	0.014	0.043

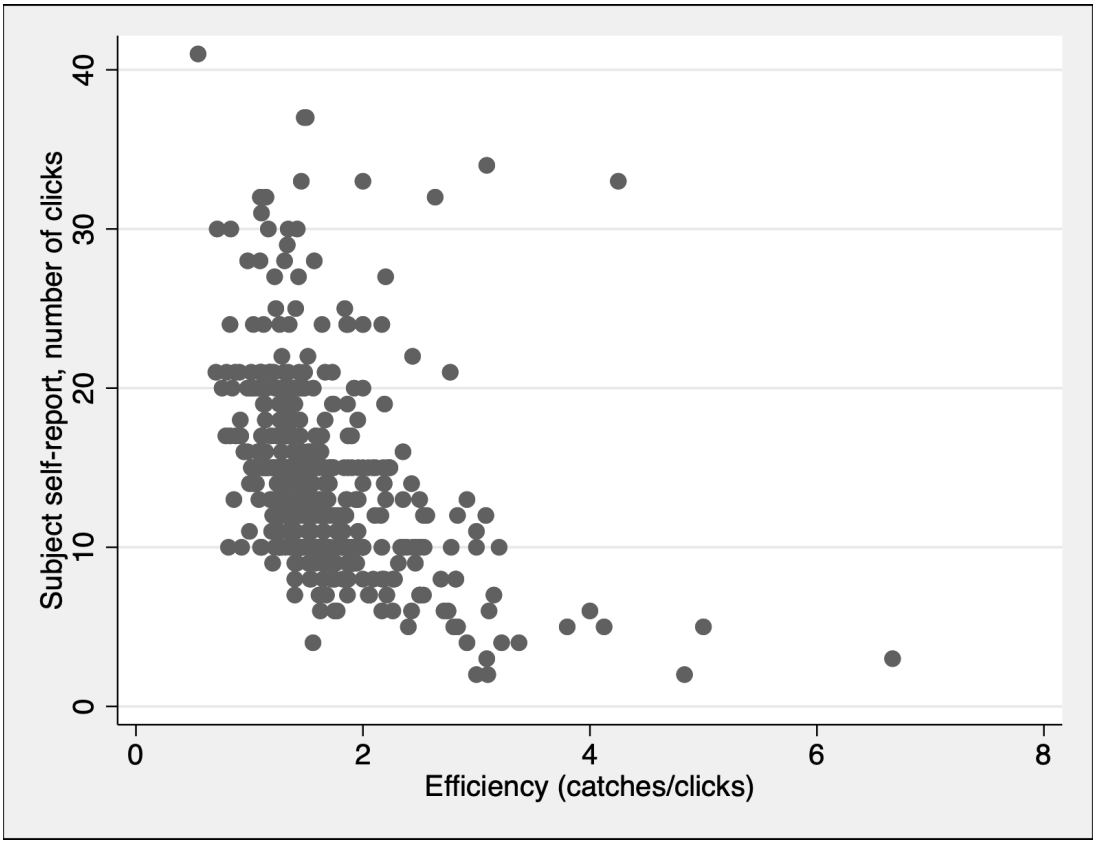
Note: Results are from logit and OLS regressions, respectively, with robust standard errors. Columns 2 and 3 are partitioned by whether subjects receive feedback on their actual investment rank (prior to investment). IOp treatment is a dummy equal to 1 if Round 3 investment funds are determined by childhood zip code, and 0 for the control group. Pre-investment rank is subjects' actual earnings rank based on the total value of the Round 3 investment funds. It is on a scale of 1-10, where higher values indicate higher earnings. Robust p-values are in brackets. Significance also indicated using stars, for reader convenience: *** p<0.01, ** p<0.05, * p<0.1

Figure 4: Predicted difference in share of earnings allocated to investment when pre-investment earnings rank is known, IOp treatment minus Control



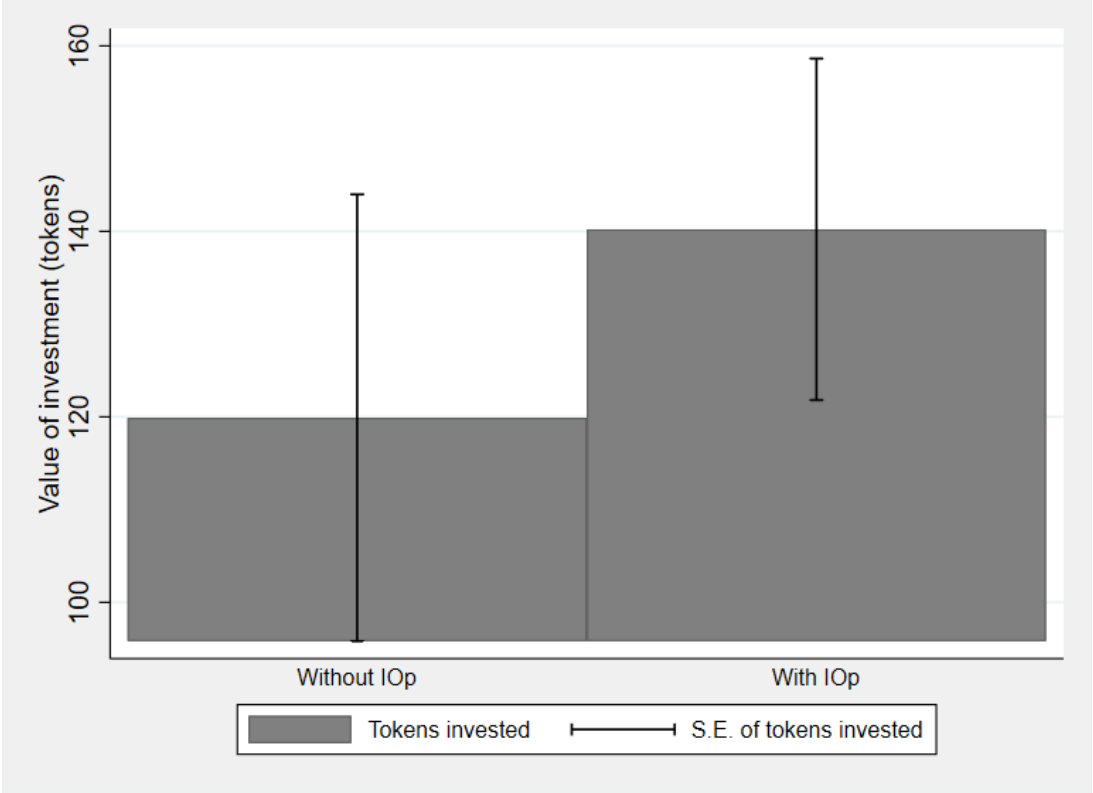
Note: Bars indicate the difference in predicted investment based on the regression results from Column 3 in Table 3.

Figure 5: Scatter of self assessment of total number of clicks against the actual click/catch ratio



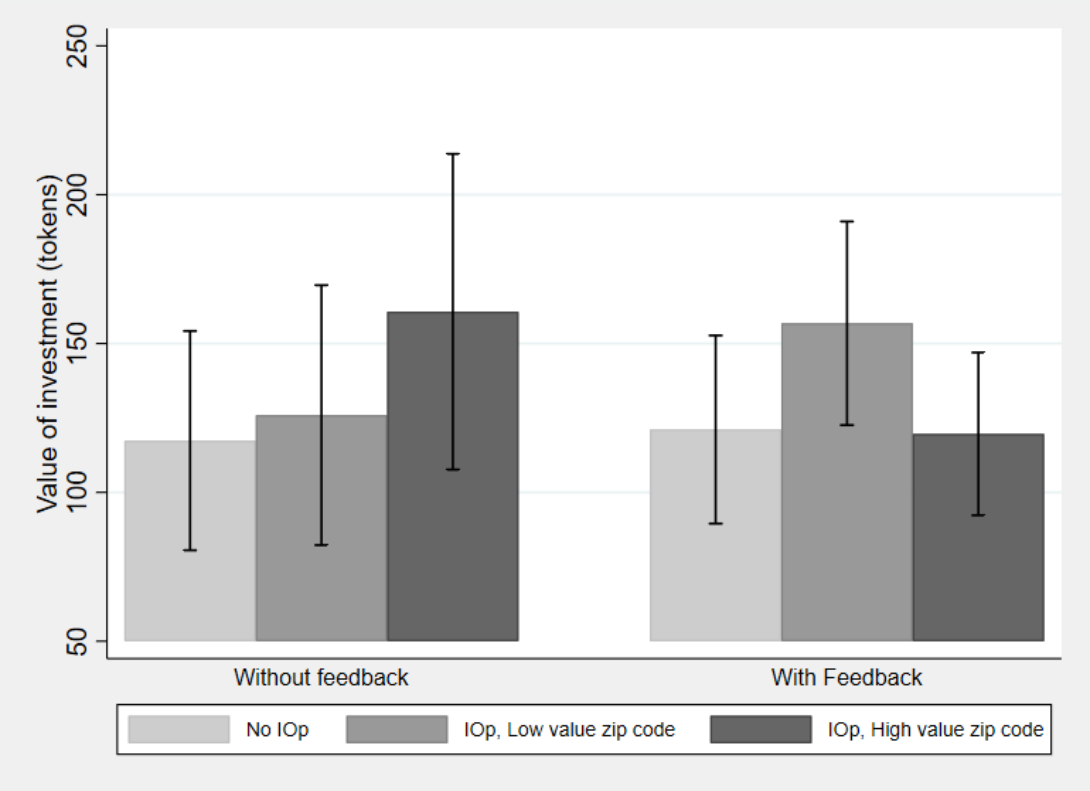
Note: One outlier with point value (0, 12.5) is omitted from this image. Including it changes the scale of the x-axis and thereby obscures the main relationship in the main data cluster.

Figure 6: Mean number of tokens invested, comparing IOp to Control (i.e. inequality only from effort)



Note: Bars indicate means and capped lines indicate standard errors.

Figure 7: Mean number of tokens invested in each treatment group (conditional on investment > 0)



Note: Bars indicate means and capped lines indicate standard errors.

A. Supplementary analysis and robustness

A.1. Perceived rank

Table A.4 shows null results from a regressions of investment choices on subjects' perceived ranks and the IOp treatment. Perceived rank was elicited after subjects learned their earning rate for calculating Round 3 funds. Inequality in the control groups comes from differential task performance (effort). Inequality in the treatment group is from both effort and IOp. The interaction terms tell the marginal impact of changes in perceived rank in the IOp group.

Table A.4: No role for perceived rank in th impact of IOp on investment behavior

	(1)	(2)	(3)
Dep var: Binary = 1 if subject chooses to invest			
	All	Without rank feedback	With rank feedback
Perceived pre-investment earnings rank	0.024	-0.266	0.115
	[0.833]	[0.204]	[0.390]
IOp treatment	7.468	7.938	6.268
	[0.377]	[0.578]	[0.559]
IOp X Perceived rank	-0.033	0.171	-0.097
	[0.807]	[0.510]	[0.543]
Constant	1.090	3.234**	0.399
	[0.143]	[0.023]	[0.651]
Observations	499	164	335
Pseudo R-squared	0.0001	0.009	0.002
Dep var: Portion of earnings invested, conditional on being > 0			
	All	Without rank feedback	With rank feedback
Perceived pre-investment earnings rank	0.333	0.917	1.55e-14
	[0.743]	[0.612]	[1.00]
IOp treatment	7.468	7.938	6.268
	[0.377]	[0.578]	[0.559]
IOp X Perceived rank	-0.917	-0.776	-0.850
	[0.495]	[0.742]	[0.610]
Constant	19.78***	14.64	22.69***
	[0.002]	[0.157]	[0.009]
Observations	385	130	255
R-squared	0.004	0.007	0.005

Note: Results are from logit and OLS regressions, respectively, with robust standard errors. Columns 2 and 3 are partitioned by whether subjects receive feedback on their actual investment rank (prior to investment). IOp treatment is a dummy equal to 1 if Round 3 investment funds are determined by childhood zip code, and 0 for the control group. Pre-investment rank is subjects' actual earnings rank based on the total value of the Round 3 investment funds. It is on a scale of 1-10, where higher values indicate higher earnings. Robust p-values are in brackets. Significance also indicated using stars, for reader convenience: *** p<0.01, ** p<0.05, * p<0.1

A.2. Robustness: type of information

Information on actual income rank entails receiving one of three types of news: whether each subject guessed their income rank correctly, underestimated it or overestimated it. Appendix Table A.5 shows that the type of news received is not correlated with investment behavior. It also shows that mean treatment differences described are also robust to controlling for

information type.

Table A.5: Results hold controlling for type of news received in feedback treatment

	Dependent variable	
	Binary = 1 if subject chooses to invest	Portion of earnings invested (conditional)
Pre-investment earnings rank	0.0871	0.0953
	[0.350]	[0.879]
IOp treatment	0.666	10.64**
	[0.223]	[0.020]
IOp X Pre-investment rank	-0.111	-1.722**
	[0.214]	[0.022]
Bad news vs Good news (0/1)	0.278	-2.196
	[0.461]	[0.490]
Constant	0.515	23.42***
	[0.436]	[6.76e-07]
Observations	335	255
Regressions include sample that received rank feedback		
(Pseudo) R-squared	0.006	0.045

Note: Results are from logit and OLS regressions, respectively, with robust standard errors. Columns 2 and 3 are partitioned by whether subjects receive feedback on their actual investment rank (prior to investment). IOp treatment is a dummy equal to 1 if Round 3 investment funds are determined by childhood zip code, and 0 for the control group. Pre-investment rank is subjects' actual earnings rank based on the total value of the Round 3 investment funds. It is on a scale of 1-10, where higher values indicate higher earnings. Bad News is a binary variable equal to 1 if the subject learned they ranked lower than they thought. It is 0 if they learned they ranked at least as good as they thought. Robust p-values are in brackets. Significance also indicated using stars, for reader convenience: *** p<0.01, ** p<0.05, * p<0.1

A.3. Earnings versus rank

In this sub-section we consider whether the difference between high and low value zipcode groups is essentially an income effect. Similar to skill, high earners may have attributes that influence their investment choices. These people will also often occupy higher income rank positions. To address this, we look at the control group. Specifically, we look at behavior of those in the control group that actually earn more but don't learn their rank. Comparing investment between high and low earners in this group will show whether there could be unobservable characteristics that link the ability to earn with investment behaviors. We look at earnings granted for use in the Round 3 investment task, and define a "high income" binary variable equal to 1 if the subject's earnings were above the median amount. We perform a rank sum test, by the high income dummy, on both unconditional and conditional investment amounts. Both tests return null results. For unconditional investment, we fail to reject the hypothesis that higher and

lower earners invest the same, at p=0.3256. We also fail to reject this hypothesis for conditional investment amount, at p=0.1827. Thus, the difference in investment behavior between high and low rank does not appear to be linked to (expected) earnings themselves.

B. Debriefing survey

1) Were you happy with your final rank? a. Yes (1) b. No (0)

2) Reflecting on the ball catching task, on a scale of 1-10, how engaging did you find it? 1 means not at all engaging and 10 means very engaging.

   Not at all engaging 1…2…3…4…5…6…7…8…9…10 Very engaging

3) You caught [autofill] balls in the catching task. What was the most important source of motivation for you? Choose one.

   a. I just like to do a good job
   b. I wanted to do better than others
   c. I was bored so did not care how many I did
   d. I got nervous about my performance, so I did not do too many
   e. I felt I had to do at least a little bit, otherwise why am I here?
   f. The rate of earnings was not high enough for me today, so I just left the basket in one place
   g. I was trying to minimize costs, so I just left the basket in one place
   h. Other: please specify

4) Reflecting on the investment task, on a scale of 1-10, how engaging did you find it? 1 means not at all engaging and 10 means very engaging.

   Not at all engaging 1…2…3…4…5…6…7…8…9…10 Very engaging

   [FOR TREATMENT – LEARNING ACTUAL RANK]

5) After confirming your income available for the investment task, you learned your rank. Did knowing your rank for earnings impact your choice in the investment task?

   a. Yes (1)
   b. No (0)

6) (If yes) How did it impact your choice?

   a. I invested MORE than I otherwise would have (1)

   b. I invested LESS than I otherwise would have (0)

[FOR CONTROL – NOT LEARNING ACTUAL RANK]

5) After confirming your income available for the investment task, you guessed your rank. Do you think it would have impacted your choice in the investment task if you had learned your actual rank? a. Yes (1) b. No (0)

   (If yes) How do you think it would have impacted your choice?

6) I was ranked LOWER than I had originally thought

   a. I would have invested MORE (2)

   b. I would have invested LESS (0)

   c. No impact (1)

7) I was ranked higher than I had originally thought

   a. I would have invested MORE (2)

   b. I would have invested LESS (0)

   c. No impact (1)

[FOR ALL SUBJECTS]

Please rate on a scale of 1-10 how much you agree with the following statements. 1 means that you completely disagree and 10 means that you completely agree.

8) I will do better in life than my parents.

   Completely disagree 1...2...3...4...5...6...7...8...9...10 Completely agree

9) I like to compete whether or not I win.

   Completely disagree 1...2...3...4...5...6...7...8...9...10 Completely agree

10) I like winning but I do not like competition.

Completely disagree 1...2...3...4...5...6...7...8...9...10 Completely agree

Please rate the following questions on a scale of 1-10, where 1 means not at all important and 10 means very important.

11) How important is it for you, in your life, to win when winners are chosen at random?

Not at all important 1...2...3...4...5...6...7...8...9...10 Very important

12) How important is it for you, in your life, to win when winners are determined based on effort?

Not at all important 1...2...3...4...5...6...7...8...9...10 Very important

13) How important is it for you, in your life, to win when winners are determined based on skill?

Not at all important 1...2...3...4...5...6...7...8...9...10 Very important

14) Please indicate which statement you agree with most:

- Hard work is the most important ingredient to success. People who work hard get ahead.
- Hard work is the most important ingredient to success, but you cannot get ahead from hard work alone, you also need luck and privilege.
- Hard work is less important than luck or privilege for achieving success.

15) Here is a list of qualities which children can be encouraged to learn at home. Which, if any, do you consider to be especially important? Please choose up to five!

– Good manners
– Independence
– Hard work
– Feeling of responsibility
– Imagination

- Tolerance and respect for other people
- Thrift, saving money and things
- Determination, perseverance
- Religious faith
- Unselfishness
- Obedience

16) Please indicate whether you more strongly identify as male or female, on a scale of 1-4:

Identify as male —1 —-2 —-3 —-4 — Identify as female

17) What is the highest level of education your parents achieved? If they do not have the same educational attainment, enter the attainment for the person with the highest of the two degrees.

a. Parents have the same degree. They each have an (add a drop down menu)
b. Father with the higher degree. He has a (add a drop down menu)
c. Mother with the higher degree. She has a (add a drop down menu)
d. Don't know.

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