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The Timing of Input Contributions, Deservingness, and Income Sharing Rules

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Abstract: The results of an experiment involving income sharing being reported here, show that rather than being largely indifferent to the stage of implementation when an input takes effect, as implicitly assumed in nearly all economic analyses, timing appears to play an important role in determining the deservingness of reward. Among other implications, these findings appear to have direct consequences for emerging rules, and proposed alternatives, for sharing in venture capital investments.

Keywords: willingness to share, joint venture, input timing, ex-ante bias

JEL Classification: C92, G24

1. Introduction

Income sharing or ownership allocation based on contribution (e.g. sharecropping, joint venture, partnership firms) is a ubiquitous phenomenon in human society (Cheung, 1968, Harrigan, 1986, Mohr and Spekman, 1994), and has attracted more attention recently due to the interest in the emergence of venture capital (Hellmann and Puri, 2002, Riyanto and Schwienbacher, 2006, Cumming, 2008, Drover, Wood and Zacharakis, 2015, Dessi, 2009, Dessi and Yin, 2012, 2015, McMullen, Wood and Kier, 2016) and angel capital (Becker-Blease and Sohl, 2007, Mitteness et al., 2012). When explaining the emergence and prevalence of various existing income sharing rules, or proposing alternative rules, economists and other analysts almost invariably focus their attention on the incentive effects they provide in securing contributions of inputs necessary to the success of the venture (Stiglitz, 1974). In doing this, they largely ignore distributive justice considerations of these contributions that many people feel may give rise to (moral) deservingness of award – which is often a prominent concern of sociologists and others (Deutsch, 1975).

The likely often common feeling that a contribution of labor or capital should only count if it arrives before the production process starts, or *ex ante*, suggests that the timing of such inputs may play an important role in determining whether or not they should count in the deservedness of income shares. This may be particularly so to the extent that these inputs are perceived as being indispensable in generating any output or value from the venture. Yet, while economic modeling typically does not explicitly rule out the role of deservingness, it usually only focuses

on final payoffs to each party with little or no regard for their timing or its nature in determining the degree of its “indispensability”.¹

Here we report the results of an experimental test of the role of timing in people’s willingness to share income from a venture – more specifically, whether they are largely indifferent to the stage of implementation when the input takes effect, as implicitly assumed in nearly all economic analyses, or feel that timing plays an important role in determining the deservingness of reward. We used a lottery experiment, designed to reflect the relevant characteristics of a typical venture capital investment, a prominent contemporary example in which income sharing is of great interest.

We elicited participants’ willingness to share a potential lottery prize with another person who is willing to share the cost of playing the lottery. The cost of the lottery ticket is relatively low (10 RMB)², with a very small probability of winning a very large prize (5 million RMB) and a very high probability of winning nothing. In both cases, the contribution of the other person is equal to half of the price of the lottery ticket, and is not conditional on receiving a repayment or reward from the subject. By implementing this design, we rule out the possibility that the subjects reward the other person in order to incentivize more contributions. Hence, the elicited willingness to pay is purely the subjects’ perceived *deservingness of reward* of the other person. The only difference is that in this case of cost sharing the contribution takes place *ex ante*, whereas in the case of compensation of potential loss (in case of the subject winning nothing) the contribution takes place *ex post*. In terms of indispensability, the event of winning the prize is not

¹ Economists have long been interested in studying time preferences in the dimension of elapsed time. According to Frederick et al. (2002), the study of time preferences dates back to John Rae (1834). Samuelson (1937) proposed the discounted utility framework, which was recently advanced with the introduction of present bias (O’Donoghue and Rabin, 2006) and hyperbolic discounting (Laibson, 1997).

² The value of the RMB at the time was about USD 1 = 6.5 RMB.

possible without the cost sharing, but possible if the compensation of loss is not there. Assuming expected utility maximization based on final *ex post* payoff, the subjects' willingness to share should not be different towards those who share their costs and those who share their losses. Thus, traditional economic models predict that our subjects should not reward the other person in a systematically different way because of the difference in timing between these two treatments.

We found that the individuals taking part in the study overwhelmingly did reward the party supplying the capital input in a systematically different way – the timing was indeed very important in making this distinction. They are on average willing to share a much greater fraction of the lottery prize if the other person shares the cost rather than sharing the potential loss. Subjects' average willingness to share is more than 3 times higher when the other person shares the lottery ticket cost, than when this person contributes the exact same sum, but as compensation for the loss. The modal choice in the former case is 2.5 million (half of the prize), while the modal choice in the latter case is 0. The subjects in our experiment seem to apply a rule of “distribution based on indispensable contribution”: they reward contribution more when it is made *ex ante* and is therefore much more likely to be indispensable in generating value to the venture. It seems indispensability of input is the key element in generating the feeling of deservingness. This finding goes largely in line with the observation on venture capital and angel capital in industries: since the investors bring in funding when the entrepreneurs need it most, and before the project are launched, they are naturally entitled a large share in the ownership or income allocation *ex post*.

The remainder of the paper proceeds as follows. Section 2 presents the experimental design, Section 3 reports the experimental results, Section 4 provides a robustness check, and Section 5 concludes.

2. Experimental Design

For simplicity, we use the framing of “buying a lottery ticket” in this experiment. Buying a lottery ticket is a very simple form of risky investment. The cost of the lottery ticket is relatively small (10 RMB), and the lottery may generate a very large prize (5 million RMB) with a very small probability, or nothing otherwise. This in many essential ways similar to investments in a highly innovative industry, where the potential return is very high, but the chance of success is very low. The subject’s role is very much like an entrepreneur who invests in the innovation project. We differentiate between two cases, where the subject either receives a contribution of half the cost of buying the ticket, or a compensation of half of the loss if the lottery ticket does not win. Intuitively, the first one is like two persons co-invest in the ticket, and the second one is like a “losing insurance” for the lottery. Or in the context of the venture capital industry, the contribution is like the seed investment from the venture capital or angel capital, while the loss compensation is like a commercial insurance of social safety net protection for the entrepreneur. In terms of final payoff, the two scenarios give the subject more or less the same monetary payoff when the winning probability is very small. In other words, if the lottery wins, the fact that the subject ends up with extra 5 million RMB or 5 million RMB plus 5 RMB does not make a big difference, while when the lottery does not win, the subjects ends up with extra 5 RMB in both cases. But one can expect that the subject’s willingness to reward should be very different. In the first case, the prize is not possible without the other party’s contribution to the cost, while in the second case, the prize has almost nothing to do with the insurance. Just like seed money is indispensable in breeding the business success of the project, while insurance has nothing to do with it. Thus, the subject is very likely to share a much larger fraction of the prize with the cost-sharing person (venture capital) compared to the insurance provider.

If the subject applies some “sharecropping” way of thinking, they should be willing to pay *half* of the prize to the cost-sharing person even without incentive concerns. That is, the subject converts the contribution of cost-sharing to share in the output on a one-to-one ratio. This is also like the arrangement with venture capital in real life. When venture capital invests in a startup firm, they usually ask for equity shares of the firm as claims for later income rights. In a way, “seed money for equity” is a common practice and semi-rule in the venture capital industry. While this rule certainly provides good incentive structure that fits the industry, we suggest that the results from this study indicate that this rule may arise due to people’s perception of deservingness: if a contribution is indispensable in generating the return, it should lead to natural rights for claims to the return. In real life, the equity ownership to venture capitals is defined and protected by contracts. In our experiment, the subject is free to choose any amount as return to the cost-sharing person. If we observe our subjects still paying about half of the total prize, this would be strong evidence that “deservingness based on indispensability of contribution” can emerge as a natural rule of order in human society. For the case of loss compensation, the subject is probably going to offer an amount akin to the price of the insurance, which is about the size of the compensation.

2.1 Survey Questions

Our empirical test was a specifically designed survey experiment in which we elicited the subjects’ answers to the following two questions.

Question 1: Suppose that you are going to buy a lottery ticket at the price of 10 RMB. The lottery ticket has a very small probability of generating a prize of 5 million RMB, and nothing otherwise. There is someone who is willing to contribute half of the cost of the ticket, so you and

he will pay 5 RMB each. In this case, what is the maximum amount you would be willing to pay him if the lottery indeed generates the prize of 5 million RMB?

Question 2: Suppose that you are going to buy a lottery ticket at the price of 10 RMB. The lottery ticket has a very small probability of generating a prize of 5 million RMB, and nothing otherwise. There is someone who is willing to pay you 5 RMB if the lottery generates nothing. In this case, what is the maximum amount you are willing to pay him if the lottery indeed generates the prize of 5 million RMB?

We use these values of the price and prize of lottery because they are the commonly used price and highest prize of major Chinese lotteries (like China Welfare Lottery and China Sports Lottery). Using these values can make the questions more “realistic”, especially to those subjects who had experience buying lottery tickets. We try to use neutral language, so the party who shares the cost or loss is called “someone” instead of “partner” or “insurer” to avoid subjects bringing too much context from real life.

The experiment employed both a between and a within subjects design to ensure that our results were not driven by individual idiosyncratic characteristics (the usual concern for between design) or the order of the questions (the usual concern for within design). As can be seen in the experimental results below, our findings indeed hold in both designs. The subjects answered either Question 1 or Question 2 in the between subjects design, and both Question 1 and 2 consecutively in the within subjects design. In the within design, all subjects answer Question 1 first before they answer question 2. We did not reverse the order of the questions because the first one is easier to understand than the second one, and seeing Question 1 first helps the subjects to notice the “if” condition in Question 2.

Note that the contribution from the other person here is not conditional on the subject paying a future reward. Hence, the sharing of the lottery prize by the subject is purely a gift exchange (Akerlof, 1982) rather than a legal or contractual obligation. Thus, the willingness to pay in our experiment is purely based on the subjects' perceived deservingness of the other person.

2.2 Theory

This section provides the theoretical predictions for subjects' willingness to share based on von Neumann and Morgenstern's (1944) seminal expected utility model, a standard model applied by economists to this type of decision making problems. The model assumes that people only care about their final *ex post* payoff, and the utility they attach to a lottery is a weighted average of their utility for the different outcomes of the lottery, where the weights are the probability of each outcome. Suppose that the subject's utility function (happiness level) is $u(\pi)$ for payoff π , and the (maximum) this individual is willing to pay is v_1 for question 1 and v_2 for question 2.

Let w be the initial wealth of the subject. The price of the lottery is 10 RMB, and the lottery generates 5 million RMB with a small probability of p , and 0 with a probability of $1 - p$. For question 1, the expected utility for the subject if the cost is not shared is:

$$U_N = pu(w + 5,000,000 - 10) + (1 - p)u(w - 10)$$

and the expected utility if the cost is shared is:

$$U_{1,S} = pu(w - v_1 + 5,000,000 - 5) + (1 - p)u(w - 5).$$

For question 2, the expected utility for the subject if the loss is not shared is also:

$$U_N = pu(w + 5,000,000 - 10) + (1 - p)u(w - 10)$$

and the expected utility if the loss is shared is:

$$U_{2,S} = pu(w - v_2 + 5,000,000 - 10) + (1 - p)u(w - 5).$$

Because v_1, v_2 are the maximum amounts that the subject is willing to pay, subjects should be indifferent between buying the ticket themselves and receiving the contribution and sharing the profit. The subject's utility in the two cases should satisfy

$$U_N = U_{1,S} = U_{2,S}.$$

This leads to $v_1 = v_2 + 5$ if people only care about their final monetary payoff. Hence, we set up the main testable hypothesis of our paper.

Hypothesis 1: *The equation $v_1 = v_2 + 5$ should hold if the subjects reward the other person equally, irrespective of whether they share their costs ex ante or their losses ex post.*

By using the utility function $u(\pi)$, we implicitly assume that the subjects' utility only depends on their own payoffs, but not payoff of the other person. We are aware of the literature on social preference in behavioral economics (e.g. Fehr and Schmidt, 1999, Charness and Rabin, 2002, Fehr and Fischbacher, 2002), where people also care about the payoff of others, or the difference between others' and own payoffs. For simplicity we do not incorporate social preference in our model, and argue that introducing social preference into the utility function ($U_{1,S}$ and $U_{2,S}$) will lead to similar relation between v_1 and v_2 , namely, they are not different in any systematic way.

2.3 Experimental Implementation

The experiment, which was used to test the prediction of theory and the role of timing of the investment as a determinant of the funding rule, was a pen and paper exercise, and the prize was hypothetical and not paid to the subjects. The subjects indicated the amount that they would be willing to pay on a decision form. There were 136 subjects in the between (68 answered

Question 1 and 68 answered Question 2) and 38 in the within subjects treatment. The experiment took place at XX University. Subjects are bachelor and master students of XX University. They are between 18 to 27 years old. Most were economics students or business majors. All were restricted participating in only once in this experiment.

3. Experimental Results

Recall that v_1 is the willingness to give for Question 1 (the other person shares costs) and v_2 is the willingness to give for Question 2 (the other person compensates the losses). The experimental results show that hypothesis 1, of equality of sharing, is clearly rejected according to the experimental results, and in many cases we observe $v_1 \gg v_2 + 5$. That is, the subjects' willingness to reward the other person is much greater when other person shares the costs instead of the losses.

The average elicited value of v_1 is 1,078,750.07 in the between design and 1,284,882.4 in the within design, while the average value of v_2 is only 332,662.65 in the between and 220,281.1 in the within subjects design. Clearly, the average v_1 is much larger than $v_2 + 5$ in both cases. The difference between v_1 and $v_2 + 5$ is significant at the 5% level according to the Wilcoxon rank sum test in both the between ($p = 0.0000$) and the within ($p = 0.0003$) subjects design, and there is no significant difference between v_1 or v_2 in the between versus the within subjects design according to the rank sum test ($p = 0.8316$ for the test on v_1 , and $p = 0.3695$ for the test on v_2) . Figure 1 shows the bar plot of the average willingness to give in both between and within treatments. In each of the treatments, the average v_1 is more than twice the size of $v_2 + 5$.

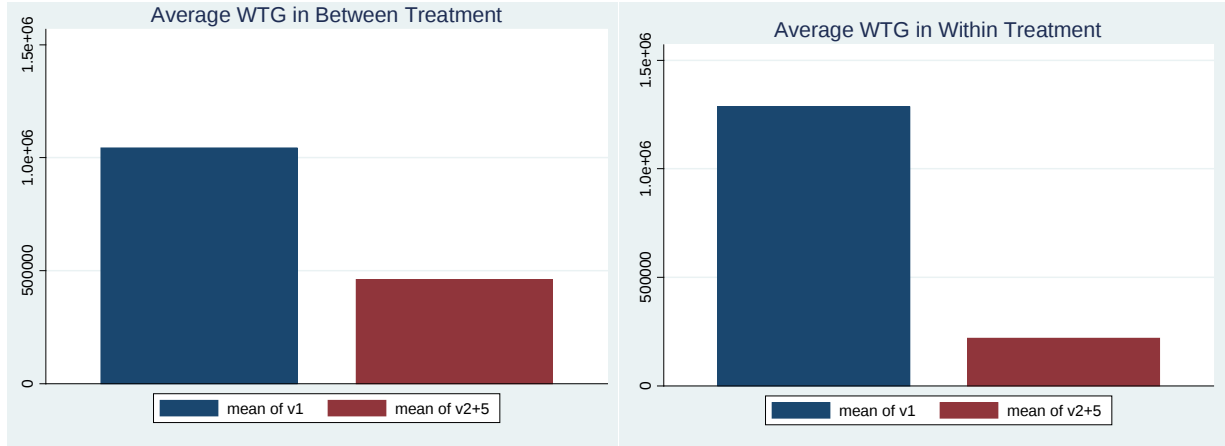


Figure 1: The bar chart of average v_1 and $v_2 + 5$ for the between (left panel) and within (right) treatment.

Further, we plot the empirical cumulative distribution function of $v_1, v_2 + 5$ in Figure 2 to examine the details of the distributions. The figure strongly suggests first-order stochastic dominance, and the difference in the distributions of the amounts that the subjects were willing to pay in response to the two questions is significant at the 5% level according to the Kolmogorov-Smirnov test, in both the between ($p = 0.000$) and the within ($p = 0.000$) subjects design.

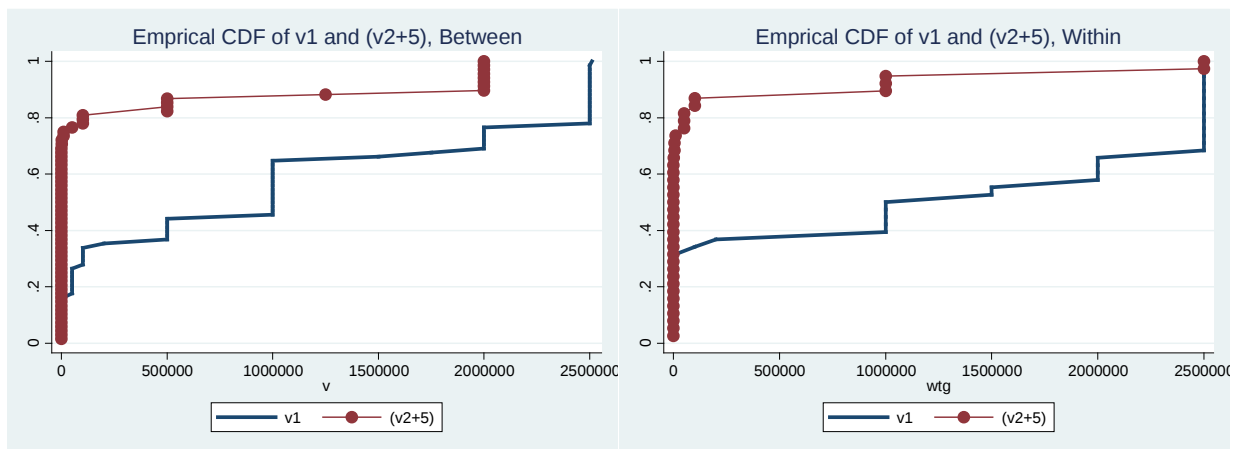


Figure 2: Empirical cumulative distribution functions of v_1 and $v_2 + 5$ in the between and within subjects treatments. v_1 is subjects' willingness to share if the other person shares half of the cost, and v_2 is the subjects' willingness to share if the other person shares of the potential losses. Economic theory predicts that $v_1 = v_2 + 5$. The experimental result suggests that subjects' willingness to share is much higher if the other person shares the *ex ante* cost than *ex post* losses.

In the between subjects design, the modal choice for Question 1 is 2,500,000, chosen by 15 out of 68 subjects. The mode of the answers to Question 2 is 0, chosen by 25 out of 68 subjects. In the within subjects design, the mode of the answers to Question 1 is 2,500,000, chosen by 12 out of 38 subjects, and 0 for Question 2, chosen by 16 out of 38 subjects. The detailed distribution of giving amounts are reported in Table 1. This finding suggests that subjects are likely to split the award equally if the stranger shares the cost of the ticket *ex ante*, but will only repay the 5RMB or even give nothing if the other person compensates their loss *ex post*.

Table 1: the numbers of choices of different giving amount v_1, v_2 in the between and within treatment.

Range	v_1 between	v_2 between	v_1 within	v_2 within
0	5	25	0	16
(0,5]	1	16	5	6
(5,100]	0	6	3	2
(100,1k]	0	2	1	1
(1k,10k]	5	2	3	3

(10k,100k]	12	4	1	3
(100k, 1M]	21	4	6	5
(1M,2.5M)	8	3	6	0
2.5M	15	6	12	2
(2.5M,5M]	1	0	1	0
Total	68	68	38	38

The result of a signed rank test on whether the average willingness to pay is equal to 0, 5, or 2,500,000 for both questions in both designs shows that the equality is rejected at 5% for all cases ($p = 0.0000$ for all cases).

The above findings can be summarized by Result 1.

Result 1: *We reject Hypothesis 1. The amount that subjects are willing to share is much higher if the other person shares their cost than if they share their loss. The majority of the subjects would be willing to give half of their prize to the other person who shares their cost, but a very low amount if the other person shares their loss.*

4. Robustness Check

Although we did not use “joint venture partner” or “insurer” framing in the experimental instructions, some may argue that people naturally associate the questions with their real life experience, and share the output according to a typical joint venture or insurance contract in the experiment. In order to pin down the role of indispensable contribution, we ask Question 3 to a new sample of subjects:

Question 3: Suppose that you are going to buy a lottery ticket at the price of 10 RMB. The lottery ticket has a very small probability of generating a prize of 5 million RMB, and zero otherwise. There is someone who is willing to lend you half the cost of the lottery ticket; that is, this individual lends you 5 RMB. In this case, what is the maximum amount you are willing to pay him if the lottery indeed generates a prize of 5 million RMB?

Question 3 is similar to Question 1 except that it frames the question in terms of debt instead of co-investment. In real life, borrowers are not obliged to reward the lender more than the amount borrowed (plus interest) in a written contract. However, borrowing-lending happens before the investment is made, and the money borrowed is indeed also indispensable for the success of the investment. Hence, if we observe that some subjects pay back half or a large fraction of the prize to the lender, it is strong evidence for people implementing the “division based on indispensable contribution” rule even if they have no obligation to do so according to any law or written contract. Let v_3 be the amount that subjects are willing to share in Question 3. The expected utility for the subject if the loan is not taken is:

$$U_{3,N} = pu(w + 5,000,000 - 10) + (1 - p)u(w - 10)$$

and the expected utility if the loan is not taken:

$$U_{3,S} = pu(w - v_3 + 5,000,000 - 5) + (1 - p)u(w - 10).$$

If v_3 is the maximum willingness to pay, it should satisfy

$$U_{3,N} = U_{3,S}.$$

This implies that $v_3 = 5$ under the assumption of expected utility maximization and no timing preference.

If our result in Section 3 is driven by a framing effect or real life experience, the answer to Question 3 should be 5, or at least very similar to Question 2, because borrowers are not required to share their revenue with the moneylender in a typical loan contract. If we observe that v_3 is much greater than 5 and close to v_1 , it would indicate that the subjects follow “distribution based on (indispensable) contribution” rule even if it is not typically written in the contract, and that the subjects even attach reward deservingness to those who lend money to them if the lending takes place *ex ante*. We propose Hypothesis 2.

Hypothesis 2: $v_3 = v_1$. *If this hypothesis is rejected and v_3 is very close to v_2 , it suggests that our result in Section 3 is driven by a framing effect instead of timing preference or the rule of “distribution based on indispensable contribution”.*

We also collected the responses to Question 3 using both a between and a within subjects design. In the within subjects design, the subjects first answered Question 3 and then Question 2, while Question 1 was not included. There were 35 observations in each treatment.

The results show that the average value of v_3 is 903,466.9 in the between and 699,515 in the within subjects design. The average value of v_2 is 430,370.4 in the within subjects design. Clearly, v_3 is larger than 5 (signed rank test, $p = 0.0000$ for the between and $p = 0.0002$ for the within subjects design). In the between subjects design, v_3 is significantly different from v_2 ($p = 0.0024$) but not significantly different from v_1 in Question 1 ($p = 0.2325$) according to the rank sum test. In the within subjects design, however, v_3 is not significantly different from $v_2 + 5$ according to the rank sum test ($p = 0.0413$). Finally, a test of the equality between the answers to Question 3 in the between versus the within subjects design shows that the difference is insignificant ($p = 0.2402$) according to the rank sum test. These findings lead to Result 2.

Result 2: *We do not reject Hypothesis 2. v_3 is not significantly different from v_1 but is significantly greater than 5 and v_2 . The result confirms that the timing preference found in Section 3 is not driven by framing effect.*

While we do not observe venture capitalists in real life using debt finance to sponsor entrepreneurs, the findings in this section suggest that they may be rewarded ownership even if they used this nominal form of debt finance. After all, the size of the loan is very small compared to the return to the investment (prize of the lottery).

5. Discussion

We elicit people's willingness to share a lottery prize with another person who contributes half of the cost or loss and find evidence for what we call *ex-ante bias*. Our results suggest that people do not just care about their *ex post* payoff, as suggested by the traditional Von Neumann-Morgenstern utility function, but they also care about how these payoffs are generated, and who contributes what in the generation of the payoffs.

Our experiment can be considered a highly stylized experiment for studying venture capital and angel capital in the real world. Venture capital and angel capital invest in start-ups and small firms in exchange for ownership equity. The projects they invested in are typically more innovative and also riskier than other projects. Venture capital and angel investors have been proven highly helpful in stimulating innovations in terms of the number of new products and patents generated from the projects. Our study suggests a natural psychological foundation for the deservingness of ownership of the venture capitals and angel investors in the projects they invest in: there appears, based on our findings, to be a widespread feeling that since they contribute funding when the entrepreneurs are in pressing need, they should be rewarded *ex post*

as a real friend indeed! In our experiment, the subject “entrepreneur” has no obligation to reward the “venture capital” who shares the cost with him. But we still see our subjects treating the cost-sharing party very much like venture capitals in real life: many of them are willing to offer 50% of the prize, like the entrepreneurs who transfer 50% of the equity to the venture capital in real life. Our finding suggests that on top of incentive considerations, the “distribution based on (indispensable) contribution” rule in the venture capital industry and many walks of life may emerge as a natural order. In this regard, our study also proposes an extension of the scope of experimental studies in entrepreneurship and business venturing (Aguinis and Lawal, 2012, Lerner, 2016).

If the subject invests 0 and the other person contributes 100% of the investment, then Question 1 in our experiment becomes a standard trust game (Berg et al., 1995, King-Casas et al., 2005, Kosfeld et al., 2005). In a standard trust game, the investor gives an amount of X to the trustee. The investment is guaranteed to grow to $3X$ and then it is the trustee’s deliberation on how much to transfer back to the investor. Trust games are widely used in the literature to study trust and investment behavior. The subject decision maker in our experiment is like the trustee in the trust game, and the cost-sharing person is like the investor. Our experiment can be considered an extension of the standard trust game where the return to the investment is uncertain, and the investor/trustee share the cost of the investment. In real life, the outcome of an investment is usually random, and subjects/trustees may share the cost of the investment at different ratios. Our extension provides extra flexibility to incorporate these features of investment problems in real life, especially those from the venture capital industry. Thus, our paper makes methodological contribution to the literature in widening the scope of the application of the trust game to investment problems.

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