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Microequity for microenterprises

Evidence from an artefactual field experiment and survey in Pakistan

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Microequity for Microenterprises: Evidence from an Artefactual Field Experiment and Survey in Pakistan

Muhammad Meki*

Abstract

Access to finance is often listed as one of the most important constraints on the expansion of small firms in low-income countries. However, several recent studies reveal that most microcredit-funded businesses rarely grow beyond subsistence-level entrepreneurship. Other evidence shows that cash and capital grants have delivered high returns to some microenterprises, and that small changes to contract structure can have a long-term effect on investment and profits. In this paper, I investigate the potential of 'microequity' contracts, which can be viewed as lying at some point on a spectrum between credit and grants, and provide a more flexible form of capital with performance-contingent repayments and a greater sharing of risk and reward. I present results from work with two of the largest microfinance institutions in Pakistan to investigate the effects of microequity contracts on microenterprises. In the first part of the paper, I describe an artefactual field experiment, designed using a simple model of investment choice under different financial contracts. This is tested with microenterprise owners who are part of a related field experiment that provides them with shared-ownership financing to expand their business. Results reveal that equity-financed microenterprise owners chose investment options with a greater expected profit than those under debt financing, with heterogeneity analysis suggesting a larger effect for more risk- and loss-averse individuals. Given the potential benefits, in the second part of the paper I present results from a field survey to provide insights on the reasons why most microfinance institutions do not actually offer microequity products. Results reveal the practical implementation challenges related to costly state verification, adverse selection into income-sharing contracts and moral hazard caused by inappropriately-tailored profit-sharing ratios.

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1 Introduction

Access to finance is often listed as one of the most important constraints on the expansion of informal micro, small and medium enterprises in many low-income countries.[1] Many existing studies focus on the role of microcredit as a source of capital; other work complements this by considering the potential effect of microsavings and microinsurance. In this paper, I consider a different approach: 'microequity'. Microequity contracts, which involve performance-contingent repayments, have the potential to provide a more flexible form of capital that could more effectively stimulate growth for *some* microenterprise in developing countries. Microequity contracts may, relative to microcredit contracts, encourage higher risk and higher return investments, by providing a form of implicit insurance to microenterprises that automatically reduces repayment requirements when business conditions are challenging. This is in comparison to microcredit and microsavings products, which often have strict payment schedules (and, in the case of microcredit, relatively high interest rates). The effects could be particularly strong for microenterprise owners whose behavioural characteristics lead them to under-invest in profitable opportunities, such as those with higher levels of risk- and loss-aversion. Such individuals may be more willing to choose riskier but higher expected-return investments when provided with the implicit insurance of microequity contracts, which mitigate the risk of losing their own wealth, compared to non-performance-contingent, fixed-repayment debt contracts. Microequity contracts also have the potential to serve hundreds of millions of low-income microentrepreneurs from the world's population of 1.6 billion Muslims, many of whom remain unbanked both by microcredit and microsavings products because of the religious prohibition on interest.

Initially, it was believed that microcredit would be an effective tool for encouraging entrepreneurship and growth of microenterprises. However, several recent studies have suggested that microloans have not had large benefits for most entrepreneurs and that microcredit-funded businesses rarely grow beyond a subsistence level of entrepreneurship. Banerjee, Karlan, and Zinman (2015) report on seven randomised evaluations of microcredit, using a variety of sampling, data collection, experimental design, and econometric strategies

[1] See Ayyagari, Beck, and Demirguc-Kunt (2007); Beck, Demirgüç-Kunt, and Martinez Peria (2008); Stein, Ardic, and Hommes (2013).

to identify causal effects of expanded access to microcredit on borrowers or communities.[2] They consistently find no transformative impact from microcredit. In particular, take-up rates were unexpectedly low, investments rarely resulted in increased profits, and none of the studies found a significant impact on average household income. Among several recommendations, Banerjee, Karlan, and Zinman (2015) identify the following key challenges for the next generation of microfinance studies: (i) investigating how innovations to microfinance contract structure can improve take-up rates and effectiveness; (ii) addressing the limited evidence on repeat borrowers; and (iii) broadening our understanding of non-credit microfinance activities. In this paper, I aim to contribute to these objectives by investigating the viability of microequity contracts, which provide a more flexible form of capital with performance-contingent repayments and a greater sharing of risk and reward, using an artefactual field experiment and a field survey with two of the largest microfinance institutions in Pakistan.

Standard microcredit contracts are often characterised by high interest rates and immediate repayment requirements. While the majority of the results from the literature on microcredit have showed little effect from standard microcredit products on the growth of microenterprises, recent evidence reveals that small changes to contract structure, such as repayment grace periods, can have a long-term effect on profits and facilitation of lumpy investment.[3] Further, cash and capital grants have delivered high and sustained returns to at least some kinds of microenterprise.[4] Microequity contracts can be viewed as lying at some point on a spectrum between credit and grants, sharing characteristics of both, by providing capital with performance-contingent repayments.

This paper draws on the work of Fischer (2013), who uses theory and a 'lab-in-field' experiment to investigate the possibility that the structure of many existing microfinance contracts discourages risky but high-expected-return investments, with a particular focus on the difference between individual- and joint-liability microcredit

[2] See Augsburg, De Haas, Harmgart, and Meghir (2015); Tarozzi, Desai, and Johnson (2015); Duflo, Banerjee, Glennerster, and Kinnan (2013); Angelucci, Karlan, and Zinman (2015); Attanasio, Augsburg, De Haas, Fitzsimons, and Harmgart (2015); Crépon, Devoto, Duflo, and Parienté (2015); Karlan and Zinman (2011). Meager (2018) jointly estimates the average effect and the heterogeneity in effects across these seven studies using a Bayesian hierarchial model, and finds support for the conclusion that the average effect on household outcomes is close to zero, while there is some evidence of a positive effect for households with previous business experience.

[3] See Field, Pande, Papp, and Rigol (2013); Battaglia, Gulesci, and Madestam (2017); Barboni (2017).

[4] See De Mel, McKenzie, and Woodruff (2008); Fafchamps, McKenzie, Quinn, and Woodruff (2014).

contracts on risk-sharing and informal transfers between pairs of individuals who have been issued a loan. He also investigates the effect of a quasi-equity contract, in which partners who are given a loan also have profit- and loss-sharing enforced on them, and finds that this contract led to increased risk-taking and expected returns relative to all other contracts (both individual- and joint-liability debt contracts), and actually produced the lowest default rates.[5]

There are over 1.6 billion Muslims in the world, representing nearly a quarter of the global population. The religious prohibition on usury (*'riba'*) means that many Muslim microentrepreneurs remain unbanked both by microcredit and microsaving products.[6] An equity-based product, though not restricted to any one particular religion or group, has the potential to meet the demands of hundreds of millions of poor Muslims, many of whom reject conventional loan products on religious grounds.[7] Research from the Islamic Development Bank reports that that in the six countries with the largest Muslim populations (Indonesia, India, Pakistan, Bangladesh, Egypt and Nigeria) the number of people living on less than $2 per day far exceeds half a billion.[8] Financial exclusion rates in India are as high as 80% for Muslims, compared to 20% for non-Muslims.[9] Recent reports by the World Bank and IMF discuss the benefits of risk-sharing products and call for innovations in equity-based contracts for micro-, small- and medium-sized enterprises.[10]

In the first part of the paper, I test a microequity contract using an artefactual field experiment, with microenterprise owners who were part of a broader field experiment, two-thirds of whom were randomly offered a relatively large amount of financing to purchase an asset for their business (using an 'equity-like', shared-ownership contract). The sample consists of growth-oriented microenterprise owners who had successfully graduated from previous loan cycles, reaching the upper limit of borrowing of $500 from Akhuwat,

[5] The major differences between this paper and Fischer (2013) are that Fischer's equity-like contract is itself a hybrid of a debt and equity contract that was implemented with participants in pairs, with the primary aim of studying informal risk sharing and transfers between these pairs of individuals. Other major differences include the characteristics of the sample: Fischer uses only females with relatively low incomes, and it is not clear how many of them were managing a business. In my context, all participants were growth-oriented microenterprise owners who had successfully graduated from previous loan cycles, reaching the upper limit of borrowing of $500, and had entered into an experiment that provided them with financing up to the value of $2,000 to expand their business with the purchase of a fixed asset using a shared-ownership contract.

[6] See El-Gamal, El-Komi, Karlan, and Osman (2014).

[7] See Nimrah, Michael, and Xavier (2008).

[8] See Obaidullah and Khan (2008).

[9] See El-Komi and Croson (2013).

[10] See World Bank (2012); Kammer, Norat, Pinon, Prasad, Towe, and Zeidane (2015).

one of the largest microfinance institutions in Pakistan, and who had expressed an interest in expanding their business by purchasing a fixed asset up to the value of $2,000. As such, this experiment has greater external validity compared to most 'lab-in-the-field' studies because all participants are actual microenterprise owners making an important investment decision for their business. The experiment was designed based on a simple theoretical model, in which a utility-maximising agent makes investment decisions in discrete time. Financial contracts are then introduced to investigate investment behaviour under equity and debt. The model predicts that agents are more likely to choose higher-risk, higher expected-return investment options when financed with performance-contingent-repayment equity contracts, compared to investment decisions taken under a fixed-repayment debt contract. This prediction is stronger for more risk-averse agents. I demonstrate the robustness of these predictions to changes in the parameters of the model, which is then tested using the artefactual field experiment with microenterprise owners. Results from the experiment reveal that equity-financed microentrepreneurs chose investment options with a higher expected return than under debt financing, with an effect size of 0.40 standard deviations. Heterogeneity analysis with pre-specified variables reveals a treatment effect that is approximately 50% larger for the most risk- and loss-averse microenterprise owners. Such individuals may under-invest in profitable opportunities due to their aversion to risk and losses; microequity contracts have the potential to stimulate profitable but more risky investment choices for this group of individuals through the implicit insurance inherent in performance-contingent repayments. However, while the welfare effects on this population of individuals could be significant, from a policy perspective microfinance institutions may not wish to provide such financing if those individuals who take the most risk under equity financing also tend to be those with the worst business management practices, education or cognitive ability. The results presented in the second part of the heterogeneity analysis help to mitigate such concerns: I find no evidence that microenterprise owners with lower business management practices, education or cognitive ability are those for whom equity contracts incentivise the greatest risk-taking relative to debt. In fact, there is evidence of the opposite effect, with the greatest impact from equity contracts on those with the highest business practices, education and cognitive ability.

Following on from the positive results from the artefactual field experiment, the second part of the paper provides some insights for why large microfinance institutions (MFIs) do not typically offer microequity

contracts alongside other products in their portfolios. Given the stated objectives of many microfinance institutions to consider borrower welfare as well as profits, it seems surprising that no large microfinance institution appears to be implementing microequity contracts, given the potential benefits, in particular for individuals whose risk- and loss-aversion may lead them to under-invest, and given the evidence that those individuals are not characterised by the lowest levels of business management practices, education or cognitive ability. To investigate this, I report on an attempt by the National Rural Support Program (NRSP), another one of the largest microfinance institutions in Pakistan, to implement microequity contracts with microenterprise owners in the field. Results from a detailed client survey and a post-survey focus group with senior management reveal the significant challenges of implementing equity-based contracts within a conventional microcredit organisation. I find that, while contracts were initially implemented with profit- and loss-sharing, gradually clients and loan officers abandoned the performance-contingent payment features and converged back to a model of fixed-repayment debt contracts. Interviews with senior management and loan officers uncover reveal key reasons for this convergence, which echo results from theoretical work that has investigated the difficulties in implementing performance-contingent contracts, such as equity or sharecropping, due to costly state verification, adverse selection and moral hazard.[11]

The second part of this paper reveals two major insights. First, from the supply-side, the main challenge of implementing equity-like contracts was related to the organisational structure of a conventional microfinance institution: specifically, how loan officers are incentivised. Loan officers in the study reported that they were familiar with disbursing a relatively high volume of loans and focusing the majority of their efforts on maximising the repayment rate of their loan portfolio, based on which they are paid a bonus.[12] Loan officers did not have much incentive to finance higher-return, higher-risk microentrepreneurs by providing them with a product that contained possible loss-sharing, especially because the loan officer would not themselves benefit from the upside portion of the entrepreneur's payment. Further, loan officers reported that it took much added effort to monitor microenterprises and their profits and losses, on which they had to calculate shared payments. These results provide some support for the theoretical result of Townsend

[11] See Townsend (1979); Stiglitz and Weiss (1981).

[12] Note that this could also lead to an incentive to re-finance the loan of a client who is performing poorly, rather than investigating whether their business is worthy of being re-financed.

(1979), who shows that under costly state verification the optimal financing mechanism is a standard debt contract, rather than performance-linked contracts that require the capital provider to monitor the microenterprise.

The second major insight relates to the incentives of microfinance clients themselves in the implementation of profit-sharing contracts. Results from the survey and interviews illustrate that many microenterprise owners had serious objections to the profit-sharing rule used in the contracts when they were originally implemented. A common sharing rule of 20-80 was applied by the MFI – where the microenterprise shared 20% of its monthly profits – but this led to the most profitable microentrepreneurs having to share too much of their profits and thus the equity product, ironically, appeared to them to be very 'inequitable'. Once again, it was beyond the remit and incentives of loan officers to spend a large amount of time auditing the accounts of the microenterprise and carefully tailoring the sharing ratio based on expected profits and losses of the business after the capital injection. Over time, loan officers and clients mutually agreed to remove the performance-contingent aspect of the contracts, which converged to a fixed repayment schedule. Had NRSP maintained performance-contingent contracts alongside fixed-repayment contracts, a serious problem of adverse selection may have developed, with the most profitable microenterprises deciding to re-negotiate to a debt contract, and the least profitable ones remaining on performance-contingent contracts. Hence, the decision taken by NRSP management to revert all contracts back to a standard fixed repayment schedule appears to have been appropriate. This decision to move back to debt-like contracts also appears prudent in light of the potential adverse consequences of moral hazard. Since a 20-80 sharing ratio was considered inappropriate by some of the more profitable businesses, in that they were obliged to share too much of their profits, had NRSP not renegotiated the contract then it could have created negative incentives for those microenterprises stuck on 'unfair' sharing ratios. This may have encouraged them either to exert less effort – for instance if they equated their marginal disutility of effort with their share of their marginal product rather than total marginal product – or to simply understate their profits, which would be difficult to detect due to costly state verification.

Intriguingly, NRSP branch managers also observed that, even though the contracts originally maintained a 'downside option' that did allow for loss-sharing ex-ante, in practice no entrepreneurs ever exercised this loss-sharing option. This was due to a fear that if they did not meet their expected payment every month, it

would adversely affect their standing with the bank, which may hinder their ability to borrow in the future. Therefore, fears regarding reputation and dynamic incentives actually led to microenterprise owners not exercising their loss-sharing option, even when NRSP had explicitly allowed it. In summary, these findings from the survey of NRSP clients suggest that it is very challenging to implement equity-based contracts within a conventional microcredit organisation. The major constraints relate to the incentives of microcredit loan officers and those of clients, as discussed in earlier theoretical work on optimal financial contracts in the presence of asymmetric information and costly state verification. These are compounded by the related problems of adverse selection (the most profitable microenterprises selecting out of equity contracts) and moral hazard (distortionary effects caused by inappropriately chosen income-sharing ratios).

The remainder of the paper proceeds as follows. In Section 2, I outline the simple model that was used to design the artefactual field experiment, which is described in Section 3, and for which results are presented in Section 4. Section 5 presents results from the field survey of NRSP clients, and Section 6 concludes.

2 A simple model of contract structure and investment choice

2.1 General setup

In this section, I outline a simple model in which an agent makes a series of investment decisions in discrete time. I describe the general setup of the model, how financial contracts are introduced (debt and equity), and the model's predictions for the behaviour of agents under the financial contract 'treatments'. The model forecasts that agents are more likely to choose investment options with a higher expected return (and higher risk) when financed with the equity contract, compared to the debt contract. This prediction is stronger for more risk-averse agents. I demonstrate the robustness of these predictions to changes in the structure of the model. This model is then used to design the experiment that is outlined in Section 3, which is implemented with microenterprise owners who are part of a large field experiment, in order to test the effect of financial contracts on investment choice.

In the model, the agent begins the game with initial wealth w_1, and makes an investment choice in each

decision round. There are T decision rounds; in each round the agent chooses from a set of j investment options, with each investment option having: (i) a good outcome g_j; (ii) a bad outcome b_j. The bad outcome always has a payoff of zero ($b_j = 0$), while the good outcome has some positive payoff ($g_j > 0$). Each outcome is equally likely. I define a payoff matrix with each row corresponding to one of the j investment options pairs (b_j, g_j). Each of the j investment options also has an associated cost, c_j. The agent chooses investment options that maximise their expected utility, subject to the constraint that their current wealth is sufficient to pay for the chosen investment option. The agent is assumed to have a constant relative risk-aversion (CRRA) utility function over wealth w_t:

$$u(w_T) = \frac{w_T^{1-r} - 1}{1 - r} \tag{1}$$

where r is the coefficient of relative risk-aversion (CRRA) (and $u(w_t) = \ln w_t$ if $r = 1$). Backward induction is used to solve the model for the optimal decisions of the agent. I begin by defining a 'wealth grid' at the terminal period T, with $[w_{T,1}, w_{T,2}, ..., w_{T,MAX}]$ representing gradually increasing values on the discretised state space for wealth, and $w_{T,MAX}$ the maximum possible wealth at T.[13] Similarly, wealth grids are created for all periods $t = 1, 2, ..., T-1$. A 'value grid' is then created for each period t, where each point on the value grid represents the utility from the corresponding point on the wealth grid at time t, based on the utility function in equation 1: $[u(w_{t,1}), u(w_{t,2}), ..., u(w_{t,max})]$. This therefore represents a discrete choice dynamic programming problem with wealth w_t as the state variable and the investment decision as the choice variable. The objective is to fill in each of these value grids, starting from the last period, and working back one period at a time. The model is solved by backward induction; in the final period T, the agent chooses the investment option that maximises their expected utility. This optimal choice of investment option is computed for every possible starting wealth level on the $T-1$ wealth grid, which leads to a vector of optimal investment choices, for each possible wealth level w_{T-1}. This is then repeated for the $T-2$ wealth grid, and so on, until period $t = 1$. This provides an optimal solution grid for each agent, based on their CRRA parameter r. Having solved the model backwards, it is then possible to 'simulate forwards' in order to generate predictions for investment choices made by agents with different levels of risk-aversion, which is outlined in Sections 2.3 and 2.4.

[13] Calculated as the number of previous rounds ($T-1$) multiplied by the maximum payoff from the set of j investment options (g_j).

2.2 Adding financial contracts

Each game is played under a different financial contract environment, described below, which affects the amount of capital with which the agent begins and the terminal payoffs at the end of the game. These different environments correspond to the 'treatment arms' in the experiment described in Section 3:

Control Treatment (CT): The control treatment is the baseline scenario, upon which different financial contract treatments are added. In the general setup, an agent begins period $t = 1$ with initial capital w_1. The agent can then choose any of the affordable j investment options; in period $t = 1$, they can afford any investment option with cost $c_j \leq w_1$. The agent selects the optimal investment option and pays the cost. The outcome of the investment option is then realised, with the agent carrying forward to the next round their initial wealth w_1, minus the cost of the investment option that they chose c_j, plus the payoff from the investment option that they chose (b_j or g_j, with equal likelihood). The game proceeds in the same manner for T rounds, after which it ends and the agent keeps whatever wealth is remaining.

Debt Treatment (DT): In the debt dreatment, the agent begins with the same initial capital w_1 as in the control treatment, but they also receive an additional amount of capital k in the form of a zero-interest loan (the debt contract with which the microenterprise owners in the experiment are most familiar).[14] At the end of the T rounds, the loan of k must be repaid in full. The main purpose of the debt treatment is that it mimics 'external financing' that is required by the agent to invest in higher expected-return investment options, which also cost more, and which the agent cannot afford when their initial wealth level is w_1 (as in the control treatment).

Equity Treatment, 50-50 Sharing (ET1): In the first equity treatment, the agent also begins with w_1 and an additional amount of capital k. However, the additional capital k is now given in the form of equity-based financing. The equity capital does not have a fixed repayment obligation at the end of the game, which is the requirement of the loan in debt treatment. Instead, there is a requirement to share all the wealth that is left at the end of the game in a 50-50 ratio (the agent keeps 50% of the remaining wealth, and shares 50%; this includes the initial wealth w_1 that they were given as starting capital).

[14] The MFI partner in this artefactual field experiment and the larger field experiment, Akhuwat, predominantly lends at zero interest.

Equity Treatment, 75-25 Sharing (ET2): The second equity treatment is identical to ET1, except that the sharing ratio at the end of the game is 75-25 (the agent keeps 75% and shares 25%).

For the financial contract treatments, an adjustment to the terminal wealth is made at the end of the game to meet all payment requirements (repaying the loan for the debt treatment, or sharing the required amount for the equity treatments). Equation 2 nests the different financial contracts:

$$Y_{T+1} = W_{T+1} - \delta.k - \alpha.\gamma.W_{T+1} \tag{2}$$

where Y_{T+1} is the total final payoff for the agent, $\delta \in \{0, 1\}$ is an indicator variable for the debt contract DT, $\gamma \in \{0, 1\}$ is an indicator variable for the equity contract ET and $\alpha \in \{0.5, 0.25\}$ controls the sharing ratio for ET. For example, when $\delta = 0$, $\gamma = 1$ and $\alpha = 0.25$ the 75-25 sharing equity contract is activated (ET2).

2.3 Model Predictions

To summarise the setup of the model, the objective for agents is to select investment options to maximise their expected utility from wealth, subject to the constraint that they must have sufficient wealth to choose the investment options (with the additional financial contract treatments relaxing the budget constraint by providing external capital at the start of the game). Agents are assumed to know the full structure of the game, including the fixed number of rounds and investment options, that each investment option is equally likely, and the terms of the debt and equity contracts. In terms of heterogeneity of preferences, all agents are assumed to be expected utility maximisers, but they vary in their coefficient of relative risk-aversion. The solution method is backward induction.

Thus far, the model has been outlined in general terms. Section 2.2 describes results from simulations that demonstrate the robustness of the final model predictions to a changing of the values of the key model parameters. The result of the analysis, and extensive testing of the game in the field, is a final preferred structure for the game, which is used in the design and implementation of the final experiment described in Section 3:

(i) Two rounds in the game;

(ii) Initial capital w_1 of 200 and external capital k of 500;

(iii) Five investment options (monotonically increasing in risk-return, as illustrated in Figure 1).

Figure 1: Investment options

Investment Option	Cost	Bad Payoff	Good Payoff	Expected Payoff	Net Expected Return
1	0	0	100	50	50
2	100	0	400	200	100
3	200	0	700	350	150
4	300	0	1000	500	200
5	400	0	1300	650	250

Note: Each row represents one of the five possible investment options, along with the cost of each option and the payoff in each of the two possible states. The expected payoff and the expected payoff net of cost are also displayed, but were not shown to the participant in the final activity.

The final model predictions can be summarised as:

Hypothesis 1 *In general, agents take more risk under equity financing.*

Hypothesis 2 *More risk-averse agents take more risk under equity financing.*

Figure 2 illustrates the optimal solution grid for the model under the preferred game structure. Each row represents the optimal investment choice, as solved for in the model, for different values of the CRRA parameter of the agent. CT, DT, ET1 and ET2 refer to the four different treatments. Each entry is a number between 1 and 5, representing the choice between the five investment options listed in Figure 1. For each treatment, there are three columns, which represent:

(i) The optimal investment choice in round 1;

(ii) The optimal investment choice in round 2, if the *bad* outcome occurred in round 1;

(iii) The optimal investment choice in round 2, if the *good* outcome occurred in round 1.

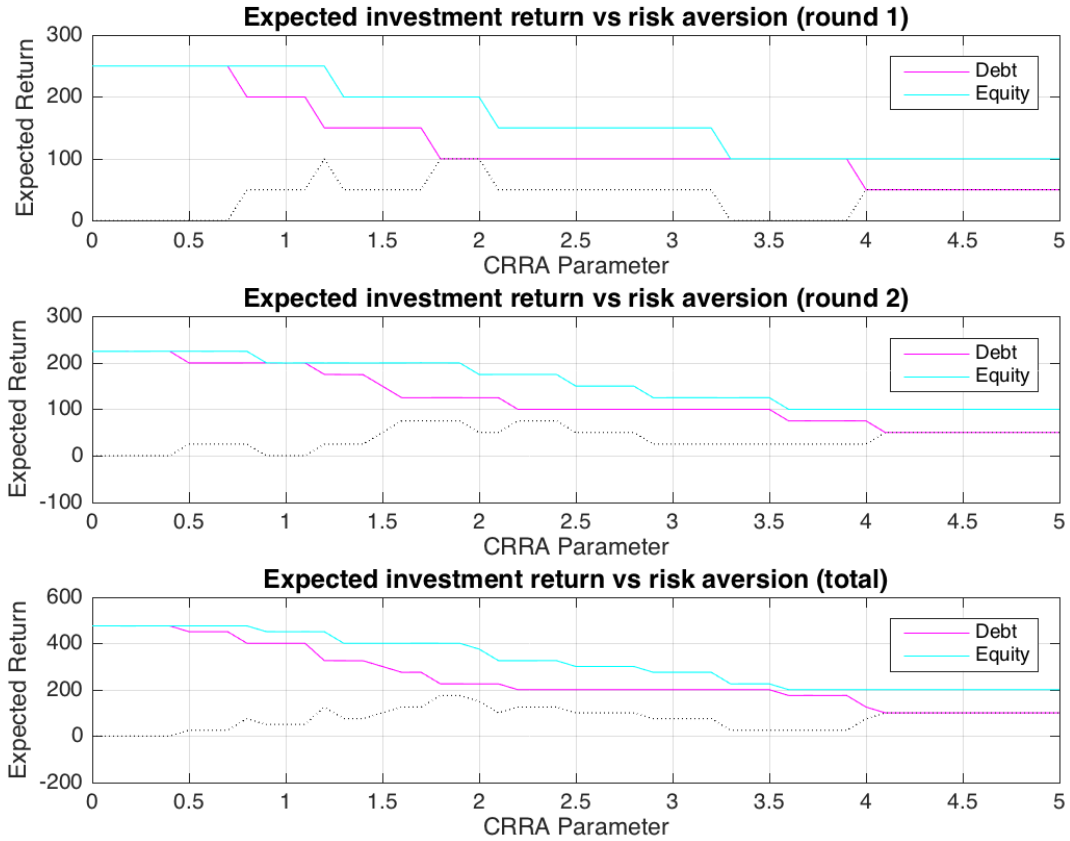
Figure 2: Model solution grid.

	CT	CT	CT	DT	DT	DT	ET1	ET1	ET1	ET2	ET2	ET2
CRRA	1	2_b	2_g	1	2_b	2_g	1	2_b	2_g	1	2_b	2_g
0.0	3	1	5	5	4	5	5	4	5	5	4	5
0.1	3	1	5	5	4	5	5	4	5	5	4	5
0.2	3	1	5	5	4	5	5	4	5	5	4	5
0.3	3	1	5	5	4	5	5	4	5	5	4	5
0.4	3	1	5	5	4	5	5	4	5	5	4	5
0.5	3	1	5	5	4	5	5	4	5	5	4	5
0.6	3	1	5	5	4	5	5	4	5	5	4	5
0.7	3	1	5	5	4	5	5	4	5	5	4	5
0.8	3	1	5	4	4	5	5	4	5	5	4	5
0.9	3	1	5	4	3	5	5	4	5	5	4	5
1.0	3	1	5	4	3	5	5	4	5	5	4	5
1.1	2	2	4	4	3	5	5	4	5	5	4	5
1.2	2	2	4	3	3	4	5	4	5	5	4	5
1.3	2	2	4	3	3	4	5	4	5	5	4	5
1.4	2	2	3	3	2	4	5	4	5	4	4	5
1.5	2	2	3	3	2	4	5	4	5	4	4	5
1.7	2	2	3	3	2	4	5	4	5	4	3	5
2.0	2	2	3	2	2	3	4	4	5	3	3	4
2.5	2	2	2	2	2	2	3	3	4	3	2	3
3.0	2	2	2	2	2	2	3	3	3	2	2	3
3.5	2	2	2	2	1	2	3	2	3	2	2	2
4.0	1	1	1	1	1	1	2	2	2	2	2	2

Note: Each number represents the optimal investment choice for an agent with a given coefficient of relative risk-aversion (CRRA) and under a given treatment environment.

As can be seen in Figure 2, the optimal solution implies greater risk-taking in the equity treatments, ET1 and ET2, than the debt treatment DT. This is reflected in Figure 3, which illustrates results from simulations of the model, pooling together the two equity treatments. Each point represents the coefficient from a regression of the expected return of the investment options chosen by an agent with a given CRRA parameter on treatment indicator variables (an OLS regression without a constant). The top two panels illustrate simulated results for the investment decisions made in the first round and second round respectively, with the bottom panel displaying the sum of the two decision rounds. In each round, it can be observed that a risk-neutral agent takes the same amount of risk under both debt and equity contracts, but for agents with CRRA parameters above 0.5 there is relatively less risk-taking under debt contracts. The gap between risk-taking under equity and debt is largest in the intermediate range of illustrated CRRA parameters, while the effect for the most risk-averse people is relatively smaller but still positive in the direction of greater risk-taking under equity.

Figure 3: Simulated results



Note: The grey dotted line plots the risk-taking under equity minus risk-taking under debt. Simulations were done in MATLAB with a simulated sample of size 300 and 300 simulations, with regressions being run for each simulated dataset. Results are also stable and similar for a lower number of simulations and smaller sample size.

2.4 Robustness simulations

Figures 15 - 19 of the Appendix illustrate results from a number of simulations, which reveal the robustness of the model's predictions to changes in key parameters. Each simulation is done with results compared to the 'baseline' specification that was implemented in the final experiment: two decision rounds, five investment options to choose from each round, starting capital of 200 and additional capital of 500 for the financing contracts.

Number of decision rounds: Figure 15 presents simulated results when the number of decision rounds in the game is changed from two to three, five, seven and ten. Results are qualitatively the same, and based on

logistical reasons and a desire not to over-burden participants, the final design included only two rounds.

Number of investment options: Figure 16 illustrates results using three, seven and ten investment options respectively. Again, predictions do not qualitatively change. Based on piloting, it was decided that five investment options provided the optimal trade-off between client comprehension and offering sufficient variation in choices.

Initial wealth level: In Figure 17, the initial level of starting capital w_1 was sequentially increased. While results reveal the same pattern of equity-financed agents taking more risk than debt-financed agents, with the effect positive for more risk-averse agents (before tailing off for the most risk-averse agents), the CRRA region in which the effect is largest shifts to the right as the initial wealth level is increased. This is an intuitive result, given that the assumed utility function exhibits constant relative risk-aversion (CRRA), which implies decreasing absolute risk-aversion (DARA), such that an agent who experienced an increase in wealth should increase their absolute level of risk-taking. Although not illustrated in Figure 17, when comparing risk-taking for each of the two treatment contracts relative to the control group, who do not get access to the additional capital of 500, it can be seen that the effect is smaller as the initial wealth level is increased. Again, this is quite an intuitive result, as less 'value' is added by the external capital treatments when the agent begins in a wealthier state. Nonetheless, the overall effect of greater risk-taking under equity than debt persists, with the difference increasing in risk-aversion up to a certain CRRA coefficient where it begins to decrease but remains positive.

Amount of external capital: Figure 18 illustrates simulated results for different values of the external capital amount k. Results remain qualitatively similar, although the effect size when the external capital amount is smallest decreases, as would be expected. It should be noted that there are potentially large differences in the welfare implications of the two financial contracts. For example, if the external capital amount is very low, the equity contracts begin to look rather 'unequal', since agents are provided with very little capital yet they are required to share a large amount of the firm's value at the end of the game.

Finally, Figure 19 presents simulations of the terminal wealth at the end of the game for the two treatments.

Results show that the equity contracts are not unambiguously 'better' than the debt contracts in terms of expected terminal wealth; in particular, for risk-neutral agents and those with a CRRA coefficient up to 0.5, expected terminal wealth is the same under both debt and equity contracts. For higher levels of risk-aversion, equity-financed entrepreneurs do end with higher terminal wealth, as would be expected given the observed greater risk-taking.

3 Experimental implementation

In this section, I describe the setup of the artefactual field experiment, which was designed to test the predictions of the model set out in Section 2, and to coincide with a broader field experiment conducted with growth-oriented clients of the fastest growing microfinance institutions in Pakistan to help them finance business expansion. Akhuwat is based in Lahore and operates in 708 branches across Pakistan, with 814,101 active borrowers and an outstanding loan portfolio of PKR 11.7 billion (approximately USD 105 million).[15] The sample consisted of microenterprise owners who had successfully completed at least one loan cycle with Akhuwat, and who had expressed an interest in expanding their business by purchasing a fixed asset. Individuals were invited to a half-day workshop, where a baseline survey was conducted and the new asset-based microfinance contract was explained to them (after this session, two-thirds of participants were randomly offered this new contract to finance an asset for their business, up to the value of $2,000). During the workshop, and after the baseline survey, enumerators conducted a detailed session of behavioural games, with the microequity game, based on the model in Section 2, as the main activity.

3.1 Summary statistics for microenterprise owners

Table 1 presents summary statistics for the microenterprise owners who participated in the study. 90% were male, with an average age of 38 and seven years of formal education. 84% were married, and the average household size was six, of which two people were typically earning some form of income. 62% of participants were themselves the head of the household, with a further 22% as the son or daughter of the household head, and 8% as the husband or wife of the head. In terms of business characteristics, the mean number of businesses in the household was 1.2, with a median of 1. The average number of years of

[15] Information correct as of 15 December 2017.

experience in that business was 9.6. The mean number of employees was 1.1, with a median of 0. Average monthly business profits were approximately US$ 253, with a median of $217, and average total fixed assets were $1,175 (median $395). Average monthly household income from all sources was $560 (median $350), and average monthly household expenditure was $218 (median $185). The most popular business sector was rickshaw driving (20%), followed by clothing and footwear production (10%), food and drink sales (8%), and retail trade in the form of fabric and garment sales (6%). As a comparison to two of the most prominent studies on microenterprises, average microenterprise profits in De Mel, McKenzie, and Woodruff (2008) were 3,850 Sri Lankan Rupees (approximately $25 at current market rates) and 125 Ghanaian Cedis ($ 27) in Fafchamps, McKenzie, Quinn, and Woodruff (2014). The average microenterprise owner in this current study is larger in terms of business profits than the two most prominent microenterprise-focused studies, which is unsurprising given that the wider field experiment targets growth-oriented microenterprise owners who had successfully completed previous loans and were looking to finance an asset for business expansion up to the value of approximately $2000. The seven microcredit field experiments summarised in Banerjee, Karlan, and Zinman (2015) contained a mixture of microenterprise-targeted products and ones with no restrictions. The most relevant comparisons would be Tarozzi, Desai, and Johnson (2015), who worked with a microenterprise-targeted loan product in Ethiopia with an approximate value of $500, Karlan and Zinman (2011), who offered approximately $220 to microenterprises in the Philippines, and Angelucci, Karlan, and Zinman (2015), who offered approximately $ 450 to Mexican microenterprises.

Table 1: Akhuwat sample: Summary statistics

	Mean	SD	10th Pctile	Median	90th Pctile	Obs.
Gender	0.1	0.3	0.0	0.0	0.0	718
Age	38.0	10.3	26.0	37.0	52.0	718
Education	7.4	3.7	0.0	8.0	12.0	718
Married	0.8	0.4	0.0	1.0	1.0	718
Household size	6.3	2.8	4.0	6.0	9.0	718
Household earners	2.0	1.2	1.0	2.0	4.0	718
Number of businesses	1.2	0.6	1.0	1.0	2.0	718
Business experience	9.6	8.1	2.0	7.0	20.0	718
Number of employees	1.1	3.1	0.0	0.0	3.0	718
Monthly profits	25,327.7	18,005.6	7,500.0	21,666.7	48,333.3	718
Total fixed assets	117,513.5	310,687.7	0.0	39,500.0	250,000.0	718
Household Income	55,967.2	73,649.0	0.0	35,000.0	120,000.0	718
Household Expenditure	21,785.4	17,266.5	9,500.0	18,450.0	36,000.0	718

3.2 Eliciting risk preferences and loss-aversion

Microenterprise owners who had expressed an interest in expanding their business with a fixed asset were invited to a half-day workshop, where a baseline survey was conducted. Prior to the microequity game, behavioural games were conducted to measure risk preferences and loss-aversion, in order to provide measures for the analysis of heterogeneous treatment effects.

The first measure of risk-aversion was survey-based, in which each respondent was asked the following four questions:[16]

(i) *"How would you rate your willingness to take risks in financial matters?"*

(ii) *"How would you rate your willingness to take risks in your occupation?"*

(iii) *"How would you rate your willingness to take risks when it comes to having faith in other people?"*

(iv) *"How do you see yourself? Are you generally a person who is fully willing to take risks or do you try to avoid taking risks?"*

The questions were adapted from Dohmen, Falk, Huffman, Sunde, Schupp, and Wagner (2011), who used a large sample to show that responses to the survey-based measure were a reliable predictor of actual risky behaviour in incentivised risk preference elicitation activities. The authors argue that relatively simple survey-based measures, compared to often quite complex paid lottery experiments, are easy to use, cheap to administer, and deliver a behaviourally valid measure of risk attitudes, which maps onto actual choices in risk preference elicitation activities with real monetary consequences.

I complemented the survey-based measure of risk-aversion with an incentive-compatible measure, using a method that provided the best trade-off between comprehension and quality of data for this population of

[16] Responses were given on a scale of 1 to 10, with 0 representing 'risk-averse' and 10 for 'fully prepared to take risks'.

microenterprise owners, as discovered through extensive piloting.[17] The final incentivised risk preference elicitation activity can be characterised as a 'certainty-equivalent method'.[18] Respondents were posed a series of 30 questions, where they were required to choose between a certain amount of money or an uncertain investment option, which had two possible outcomes: (i) a 'bad' outcome, with a payoff of zero; or (ii) a 'good' outcome, with a payoff of PKR 1,000.[19]

In the risk preference elicitation activity, there were three sets of ten questions. Each of the three sets had a different probability of a good outcome and bad outcome, which was illustrated using four coloured balls. In the first set of 10 questions, participants were shown a bowl that contained four balls: one green and three red. This reflected a probability of the good outcome of 25% (winning PKR 1,000) and 75% for the bad outcome (receiving nothing). Participants were also shown a sheet to graphically illustrate the possible outcomes for the uncertain option (as illustrated in Figure 4). Participants were asked to choose between the uncertain investment option (which had an expected value of PKR 250, although no mention of expected values was made to participants) and a certain payment of money. For example, in the first question, they were presented with a certain payment of zero versus the uncertain option.[20] In the second question, participants were offered a certain payment of PKR 100 or the uncertain option (with the uncertain option still being that illustrated in Figure 4). The response recorded by enumerators, who explained the activities carefully and conducted a number of practice rounds with participants to test understanding, was either a '1' (if the participant selected the certain payment for that question) or a '0' (if the participant took the risk of the uncertain investment option). As such, for this first set of 10 questions, each participant finished with a score between 0 and 10,

[17] I previously tested the well-known Ordered Lottery Selection design, which was developed by Binswanger (1981) and used by many authors, such as Fischer (2013), but decided against it for two main reasons that are explained in more depth in Harrison and Elisabet Rutström (2008): (i) probabilities are restricted to 0.5, which does not allow one to make inferences about probability weighting, which plays a major role in alternatives to Expected Utility Theory, such as rank-dependent utility models; and (ii) the use of a certain amount for the first investment choice may frame the investment choices in a way that makes them 'sign-dependent', such that the certain payment provides a clear reference point from which participants may identify gains and losses. I also tested other more sophisticated risk preference elicitation methods, such as the well-known Multiple Price List (MPL) design of Holt and Laury (2002), where subjects were presented with a choice between two binary lotteries, and the probabilities on each lottery were varied for different decisions. Based on piloting, I considered this risk elicitation method to be too complicated for the population at hand, which would have resulted in a large portion of the data needing to be discarded due to a lack of participant comprehension.

[18] I adapted the measures used by Barr and Packard (2002) and Vieider, Lefebvre, Bouchouicha, Chmura, Hakimov, Krawczyk, and Martinsson (2015).

[19] This was equivalent to approximately $10 at the prevailing market exchange rates.

[20] This was essentially a test of comprehension, since no-one was expected to accept a certain payment of zero versus an uncertain option with a non-zero expected value and a minimum payoff of zero.

with a higher number indicating a higher level of risk-aversion (choosing the certain payment more often). Most participants would be expected to initially choose the uncertain investment option (compared to a certain payment of zero) but, at the point of a sufficiently high certain payment being offered, would switch to choosing the uncertain investment option. After switching, they would then be expected to accept all greater amounts for the certain payment rather than the uncertain investment option. While participants were in principle allowed to make 'multiple switches', which means switching back to preferring the uncertain option compared to a greater certain payment, this would be a clear sign of lack of comprehension of the activity or unclear explanation by enumerators.[21]

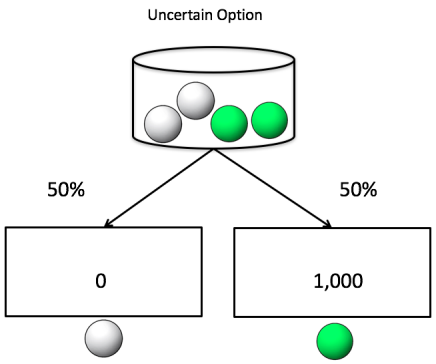
In the second set of 10 questions, the mix of balls was changed to two green and two red, reflecting an equal probability of the good or bad outcome. The same set of 10 questions was then asked: *"Do you prefer x for certain or the uncertain investment option?"*, where x increased from 0 to 1,000 in increments of 100, with real money being used for display purposes. In the third set of 10 questions, the mix of balls became three green balls and one red ball, reflecting a probability of the good outcome of 75%. At the end of the activity, it was possible to construct a risk-aversion index with a number between 0 and 30 for each respondent, with higher numbers reflecting greater risk-aversion.[22] Before the activities were conducted, some non-inentivised questions to check the cognitive ability of participants were also asked.[23]

[21] Collected data reveal that there was relatively little multiple switching (less than 3%), which likely reflects many practice rounds and careful explanation, as well as the participants knowing that their inputted data was being monitored on a regular basis. Sessions were conducted in a large hall in and under the monitoring of up to three research assistants and one of the principal investigators on the project. The data was collected using tablets and uploaded to SurveyCTO immediately after each survey. A project manager was then able to download and check the data to monitor collection and detect errors, which addressed by directly contacting the responsible enumerator.

[22] The purpose of varying the probability of a good outcome was to allow for testing of non-linear probability weighting in future work.

[23] These included number recall exercises, simple calculations and questions to test understanding of probabilities when drawing balls from a bag, which was the format used to explain probabilities throughout the activities.

Figure 4: Demonstrating the uncertain investment option



Having elicited risk preferences using two separate measures, the final activity elicited possible loss-aversion.[24] Individuals were presented with a series of investment decisions, which they could either accept or reject. Each was a binary equal-probability lottery, with the 'good' payoff being a positive value of PKR 1,000, and the bad payoff being some negative number x. x started at a low number (- PKR 100) and the individual had to decide whether they would accept or reject a binary lottery that either paid PKR 1,000 or led to a loss of PKR 100. If a loss was incurred in the activity, then the amount of loss would be taken from the individual's participation fee of PKR 1,000; as such, it was a 'real' loss that was being considered. The next question required the participant to accept or reject a binary lottery that either paid PKR 1,000 or led to a loss of PKR 200. A rejection was coded as '1' and an acceptance as '0'. 10 such questions were asked, with the loss amount increasing by PKR 100 each time. In the end, each individual had a score between 0 and 10, which indicated how many of the 10 investment options they rejected, and provided an incentive-compatible measure of loss-aversion for the microenterprise owner.

Before conducting all activities, participants were informed that, at the end of the behavioural games session, one of the incentivised activities would be selected for payment by physically drawing a ball from a bag. Within the selected activity, balls would be drawn to select the one final question that would be used for payment. As such, participants were required to answer all questions attentively, because any question could have been selected. This method also allowed the use of payment amounts that were relatively large, with the average payment being approximately three times as large as median daily business profits for

[24] I adapted the measure used by Bartling, Fehr, and Herz (2014).

microenterprises in the sample. From a methodological perspective, Charness, Gneezy, and Halladay (2016) show that paying for only a (randomly selected) subset of all activities is at least as effective as paying for all of them, and can actually be more effective in terms of helping to avoid wealth effects and hedging within the behavioural games session. Further, compared to most other 'lab experiments', which have been criticised as not accurately reflecting behaviour in the field due to a number of reasons including 'small stakes' and unrepresentative student samples,[25] the experiment in this paper uses a highly relevant population. These individuals were all growth-oriented microenterprise owners who were taking part in a large field experiment that randomly offered two-thirds of them a large amount of financing for a fixed asset; therefore, concerns about attentiveness are significantly reduced and payment amounts are relatively large.[26]

3.3 Basic Structure of the Microequity Game

Following the risk preference elicitation activity, the microequity game was conducted. Before learning the structure of the game, participants were carefully introduced to the concept of the game using a vignette. This described the story of an entrepreneur who was starting a new business, which would then be closed after a period of two years due to their need to migrate to another city. The entrepreneur in this vignette began with some amount of wealth, and had the possibility of obtaining additional financing through external capital, either in the form of: (i) a zero-interest loan, to be paid at the end of the two years; or (ii) equity capital, which required a 50-50 or 25-75 sharing of all that was left in the business at the end of the two years. A number of example scenarios for the value of the firm at the end of the two years were described, as well as an illustration and calculation of the required payments under the different financial contracts. Finally, participants were tested on their understanding of the contracts, using similar examples but with different numbers for the value of the firm at the end of the two years (specifically, one scenario where the firm was very profitable, and one scenario where it was not profitable); participants were then asked to calculate the required payment under the different contracts.

Following the introduction to the concept of raising external capital in the form of debt or equity, and how one calculated the terminal payoffs at the liquidation of the firm (which was analogous to the terminal payment at

[25] See Levitt and List (2007).
[26] The average payment amount was approximately $20.

the end of the proceeding microequity game), participants were shown to the microequity game itself. As mentioned, the microequity game was designed to match the structure of the model described in Section 2:

(i) Two decision rounds: in each round, one of the five different investment options had to be chosen, conditional on it being affordable; participants were only allowed to use money provided to them in the game;[27]

(ii) Starting capital of 200 for the control treatment (CT);

(iii) Additional capital of 500 for the debt treatment (DT), to be repaid at the end of the second round;

(iv) Additional capital of 500 for the equity treatment (ET), which required sharing of all money remaining at the end of the second round using a 50-50 or 25-75 split.

3.4 Strategy Method

I used a strategy method to elicit second-round investment decisions, rather than having participants choose an investment option for round 1 and then actually drawing a ball from a bag to determine the outcome (after which they would have had to make their second round decision). As well as providing twice as much second-round information,[28] the strategy method mitigated undesirable behaviour whereby a person who chose a number that led to a good outcome would perceive something 'lucky' about that number and continue to choose it in the second round, regardless of their underlying preference over the risk and return of the different options.[29] Participants were initially asked to make their choice of investment in round one from one of the five investment options illustrated in Figure 5. Participants were informed that each investment option had a cost, and once that cost had been paid, each investment had an equally-likely good or bad outcome, as demonstrated using Figure 6. Participants were then asked the following two questions:

[27] The microequity game, as well as all behavioural games, used real monetary notes for both demonstration purposes and the final decisions. Piloting suggested that the use of paper tokens reduced the seriousness with which participants viewed the activity. Further, all numerical values corresponded to actual amounts in Pakistani Rupees (PKR), to avoid confusion mapping from game units to real units. As mentioned, the procedure of only paying out for one activity at the end of the workshop allows for the use of relatively large payment amounts for each activity.

[28] If one used the actual realisation of first-round outcomes to frame the second-round decision, one counterfactual second round decision would never be observed.

[29] Such behaviour was indeed observed among some participants during piloting.

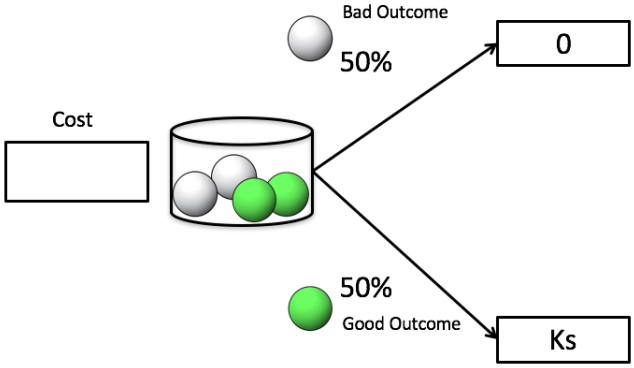
(i) *"If the bad outcome occurs from the investment choice you just chose for the first round, which investment option would you then choose in the second round?"*

(ii) *"What about if the good outcome occurs from the investment choice you just chose for the first round; which investment option would you then choose in the second round?"*

Figure 5: Set of investment options

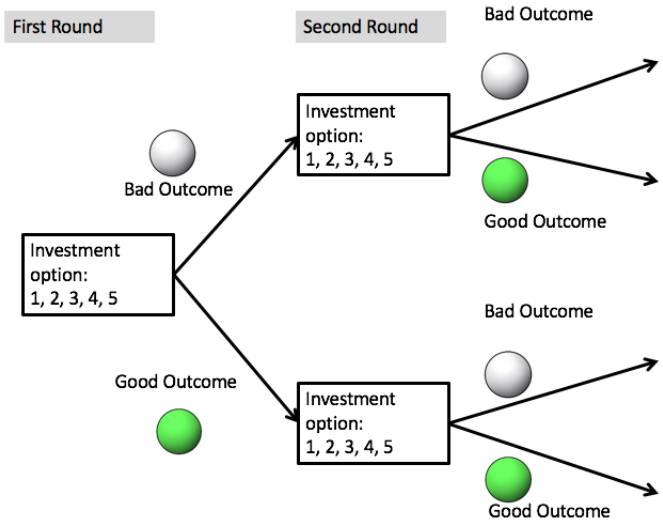
			
Investment Option	Cost	Bad Outcome	Good Outcome
1	0	0	100
2	-100	0	400
3	-200	0	700
4	-300	0	1000
5	-400	0	1300

Figure 6: Outcome of an investment option



Enumerators spent a considerable amount of time explaining the structure of the game to participants, and a number of practice rounds were conducted to test understanding before the final decisions. Figure 7 illustrates the tree diagram that was used to explain the structure of the entire game to participants.

Figure 7: Game structure



3.5 Randomisation of Financial Contract Treatments

After completing a demonstration round with participants, where they practised the game under each treatment, the final activity was conducted. To mitigate learning effects, the order in which the participants played the three financial contract treatments was randomised.[30] It is important to note that, when communicating with participants, the word 'treatment' was never used, nor were the words 'debt' or 'equity'; instead the more neutral words 'loan contract' and 'sharing contract' were used (in the local language). The purpose of the experiment was to study the effect of the contractual structure on investment behaviour, rather than any effect driven by using those possibly emotive terms. However, all participants had previously taken a loan from Akhuwat and successfully repaid it, and therefore it is much less likely that they would have had an aversion to debt contracts.

4 Experimental results

In this section, I present results from the artefactual field experiment, which took place between December 2016 and February 2018. The main outcome variable, empirical specifications, and variables for heterogeneity

[30] In order to reduce confusion from switching from equity to debt and then back to equity, the two equity treatments always appeared next to each other, although the order in which the two equity treatments appeared was also randomised.

analysis were pre-specified at the American Economic Association's RCT Registry.[31] The sample consists of 2,872 observations from 718 unique microenterprise owners, representing one decision per respondent for each of the four treatment groups (CT, DT, ET1, ET2). Decisions under the two equity contracts are pooled into one treatment indicator (ET) in the subsequent analysis.

4.1 Main result: Greater risk-taking under equity contract

Table 2 presents results using the following simple specification:

$$y_i = \beta_0 + \beta_1 DT_i + \beta_2 ET_i + \varepsilon_i \tag{3}$$

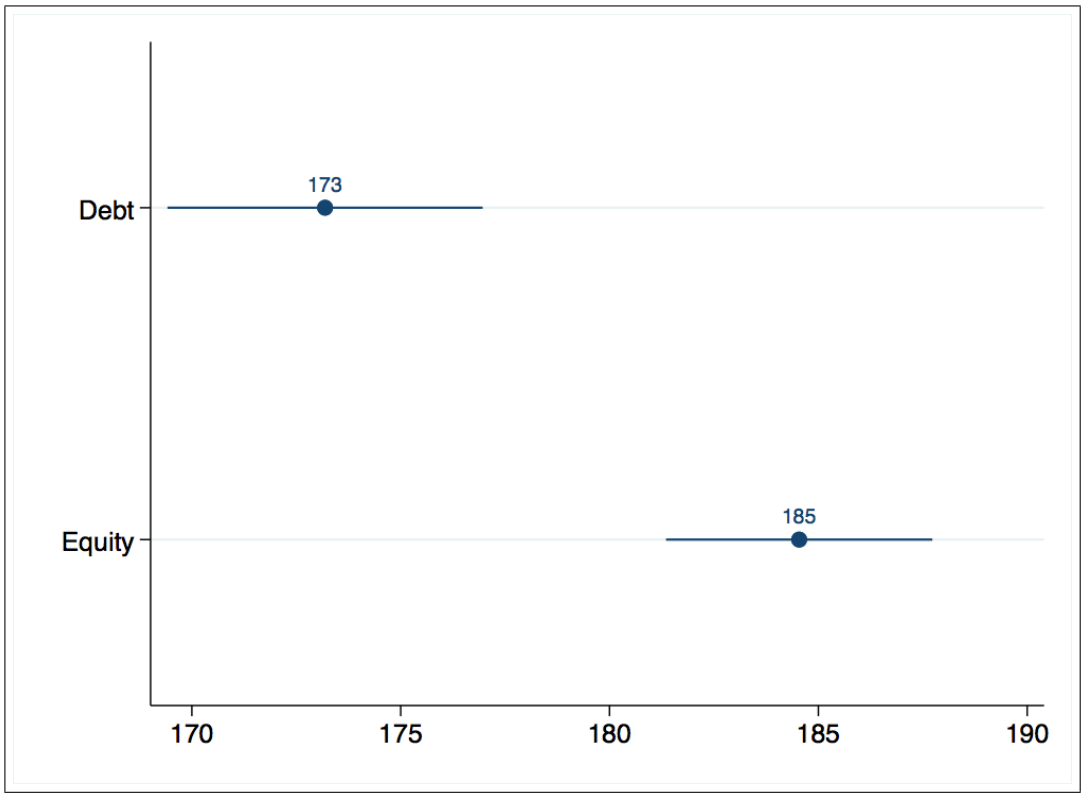
where y_i is the expected return of the investment options chosen by individual i in round 1, DT_i is an indicator variable that equals one for all investment decisions made under the debt treatment, and ET_i is the equivalent indicator variable for the equity treatments. Standard errors are clustered at the individual level. β_0 represents the average expected return of the investment option chosen by individuals in the control group, whilst β_1 and β_2 represent the additional risk taken by debt-financed and equity-financed individuals relative to the control group, respectively. The main hypothesis I test is $H_0 : \beta_1 = \beta_2$. Table 2 presents the main result of the experiment. Equity-financed microenterprise owners chose investment options with an expected return of 185, compared to an expected return of 173 under the debt contract. This represents an effect size of 0.40 standard deviations of the control group's distribution of investment choices, where the average expected return was 109, and is statistically significant at the 1% level. In Section 4.4, I present evidence that this overall result is robust to a number of alternative specifications, including using the outcomes of second-round decisions. Further, in Tables 3 - 9, where heterogeneous treatment analysis using a set of pre-specified variables is presented, the average expected return under equity is greater than under debt in every sub-group.[32]

[31] See https://www.socialscienceregistry.org/trials/2224.

[32] While all variables used in the heterogeneity analysis were pre-specified, the fact that they were trichotomised was not specified. In each of Tables 3 - 9, I provide results using both a median split and terciles for the heterogeneity variable.

Table 2: Overall effects

	(1) Expected return	(2) Expected return	(3) Expected return
ET	76***	76***	76***
	(0.00)	(0.00)	(0.00)
DT	64***	64***	64***
	(0.00)	(0.00)	(0.00)
Order effect			2
			(0.42)
Constant	109***	109***	108***
	(0.00)	(0.00)	(0.00)
Observations	2872	2872	2872
R-squared	0.26	0.46	0.26
ET vs DT (Percent)	6.6	6.6	6.6
ET vs DT (Standard deviation)	0.40	0.40	0.40
Test: ET = DT (p-value)	0.00	0.00	0.00



In all columns of the top panel, the dependent variable is the expected profit of the chosen investment option. DT and ET represent indicator variables for the debt and equity contracts respectively, with the reported coefficient estimate representing the average expected profit of investment options chosen under each treatment, relative to the control group (represented by the coefficient on the constant). Standard errors are clustered at the individual level and are reported in parentheses below each coefficient estimate. *** p<0.001, ** p<0.05, * p<0.10. The bottom panel presents the result graphically, with each point representing the *total* risk taken under each treatment contract, with 90% confidence intervals shown around each point estimate.

4.2 Heterogeneous treatment effects: Risk-aversion and loss-aversion

The purpose of the first section of heterogeneity analysis, presented in Tables 3 - 5, is to investigate potential mechanisms through which the structure of contracts may affect investment behaviour. In all columns of panel (a), the dependent variable is the expected profit of the chosen investment option. Columns (1), (2) and (3) present results for the bottom, middle, and top terciles of the respective heterogeneity variable, while columns (4) and (5) present results from the sub-sample with below- and above-median values respectively. DT and ET are indicator variables for the debt and equity contracts respectively, with the reported coefficient estimate indicating the average expected profit of investment options chosen under each treatment, relative to the control group (represented by the coefficient on the constant). In the bottom panel of each table, results are presented graphically, with each point illustrating the *total* risk taken under each treatment contract, with 90% confidence intervals shown around each point estimate.

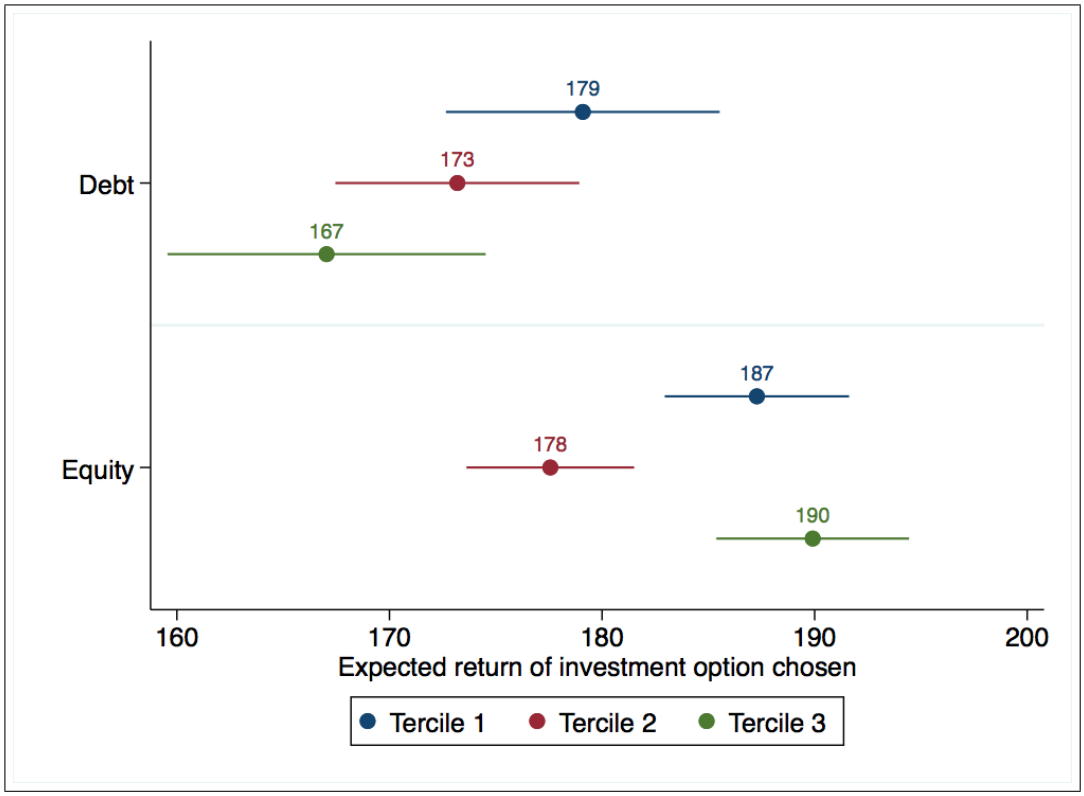
4.2.1 Risk-aversion

Entrepreneurs who are more risk-averse may take relatively greater risk when financed with an equity contract, where there is an insurance-like element through the explicit sharing of losses, compared to when they are financed with a fixed-repayment debt contract. Tables 3 and 4 display regressions and graphical analysis using the two different measures of risk-aversion. Each of the first three columns in the top panel shows a separate regression using the specification in equation 3 for individuals in the different sub-groups.

Column (1) of Table 3 presents results for the least risk-averse entrepreneurs (the most 'risk-tolerant'), with column (2) showing results for those with an intermediate level of risk-aversion, and column (3) for the most risk-averse, using the survey-based measure. In all three specifications, the expected return of investment options chosen under equity is greater than that under debt, mirroring the overall results described in Section 4.1. The magnitude of the difference between risk-taking under equity compared to debt increases for the most risk-averse microenterprise owners. Specifically, for the most risk-averse tercile, risk taken under equity is 0.80 standard deviations greater than risk taken under debt, with the effect statistically significant at the 1% level. This compares to a difference of 0.29 and 0.15 standard deviations for the first two terciles of risk-aversion respectively, using this survey-based measure. A similar result can be seen in the median split

Table 3: Heterogeneity analysis: Risk preferences (survey-based measure)

	(1) Tercile 1	(2) Tercile 2	(3) Tercile 3	(4) Below-median	(5) Above-median
ET	74***	68***	87***	70***	82***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
DT	66***	64***	64***	62***	67***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	113***	110***	103***	113***	105***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	928	1052	892	1500	1372
R-squared	0.26	0.25	0.29	0.24	0.29
ET vs DT (Percent)	4.6	2.5	13.7	4.8	8.5
ET vs DT (Standard deviation)	0.29	0.15	0.80	0.29	0.51
Test: ET = DT (p-value)	0.01	0.12	0.00	0.00	0.00



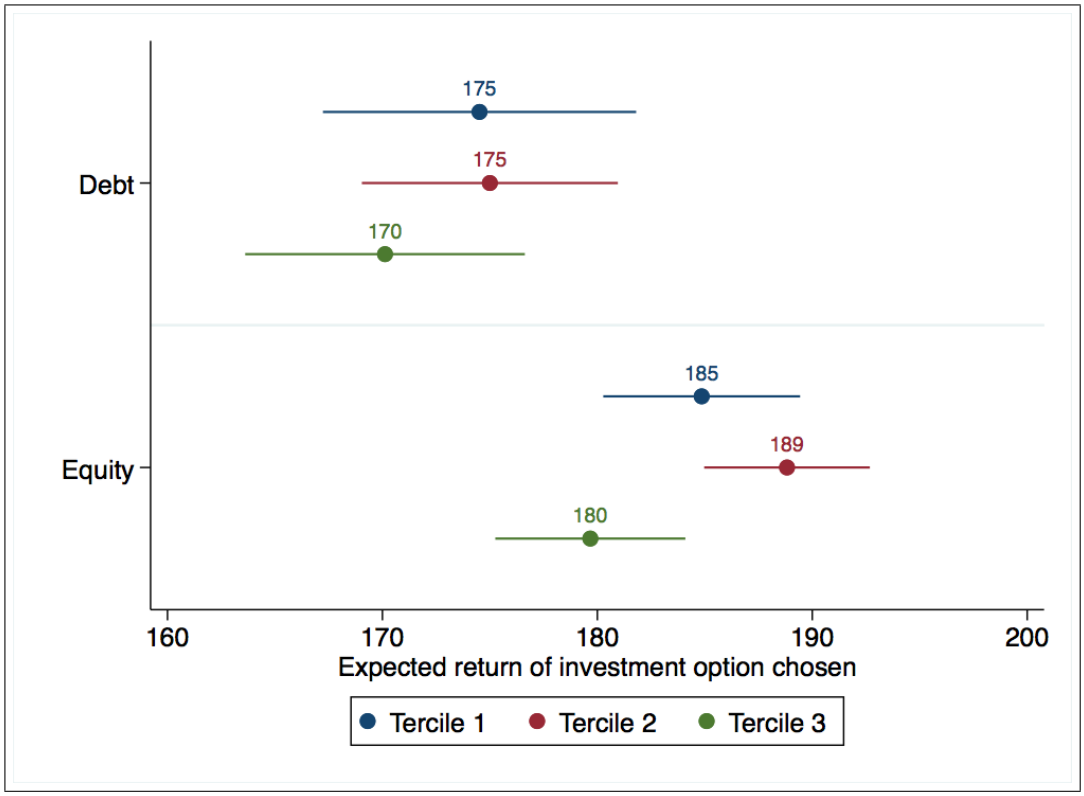
In all columns of the top panel, the dependent variable is the expected profit of the chosen investment option. Columns (1), (2) and (3) present results for the bottom, middle, and top terciles of the heterogeneity variable respectively. Columns (4) and (5) present results from the sub-sample with below- and above-median values respectively. ET and DT represent indicator variables for the equity and debt contracts respectively, with the reported coefficient estimate representing the average expected profit of investment options chosen under each treatment, relative to the control group (represented by the coefficient on the constant). Standard errors are clustered at the individual level and are reported in parentheses below each coefficient estimate. *** p<0.001, ** p<0.05, * p<0.10. Panel (b) presents the results from the heterogeneity analysis graphically, with each point indicating the *total* risk taken under each treatment contract, with 90% confidence intervals shown around each point estimate.

analysis of columns (4) and (5), with an effect size of 0.29 standard deviations for those with below-median risk-aversion and 0.51 standard deviations for those with above-median risk-aversion (both statistically significant at the 1% level).

Turning to the incentivised measure of risk-aversion, Table 4 reveals that the most risk-tolerant tercile took on average 0.36 standard deviations more risk under equity compared to debt, and that this magnitude increases for those with intermediate risk-aversion, with an effect size of 0.48 standard deviations. For those who were most risk-averse in the incentivised risk-aversion activity, the effect size decreases back down to 0.33 standard deviations. The median-split analysis of columns (4) and (5) reveals an effect size of 0.36 standard deviations for those with below-median risk-aversion and 0.43 standard deviations for those with above-median risk-aversion (both statistically significant at the 1% level). One possible reason that the largest effect size is seen with the top tercile of risk-aversion for the survey-based measure, whereas for the incentivised measure it was seen with those with an intermediate level of risk-aversion, is that those who are defined as 'most risk-averse' using the incentivised measure are displaying quite an 'extreme' form of risk-aversion, compared to those who are self-reporting as risk-averse in the survey-based measure. The two measures of risk-aversion are significantly correlated, but the correlation coefficient is 0.267 for the raw measure and only 0.222 for the trichotomised measure (both statistically significant at the 1% level), and thus the 'most risk-averse' group defined by the two different measures could be quite distinct. Investigating the choices made by those in the top tercile of the incentivised measures confirms the rather extreme level of risk-aversion; the average person in the top tercile of risk-aversion rejected all 30 offers of the risky investment option, even when the certain payment offered was only PKR 100 (compared to an average expected return of the risky investment option of PKR 500, and even when the expected return of the risky option was increased to PKR 750). As a comparison, the most risk-tolerant tercile on average only rejected 11 of the risky investment options, and accepted 19 of them. It could be argued that this result for the most risk-averse tercile may be due to a cultural 'gambling aversion', given the Pakistani conservative Muslim context, yet all these participants who displayed extreme risk-aversion were willing to make risky decisions in the microequity game. There were also no reports of any of the microenterprise owners refusing to participate, so it appears that this behaviour does in fact reflect an extreme form of risk-aversion. Referring back to the model predictions in Section 2, the effect

Table 4: Heterogeneity analysis: Risk preferences (incentivised measure)

	(1) Tercile 1	(2) Tercile 2	(3) Tercile 3	(4) Below-median	(5) Above-median
ET	71***	79***	77***	69***	82***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
DT	60***	65***	67***	59***	70***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	114***	110***	103***	114***	104***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	832	1056	984	1396	1476
R-squared	0.23	0.30	0.26	0.24	0.29
ET vs DT (Percent)	5.9	7.9	5.6	5.9	7.1
ET vs DT (Standard deviation)	0.36	0.48	0.33	0.36	0.43
Test: ET = DT (p-value)	0.00	0.00	0.00	0.00	0.00



In all columns of the top panel, the dependent variable is the expected profit of the chosen investment option. Columns (1), (2) and (3) present results for the bottom, middle, and top terciles of the heterogeneity variable respectively. Columns (4) and (5) present results from the sub-sample with below- and above-median values respectively. ET and DT represent indicator variables for the equity and debt contracts respectively, with the reported coefficient estimate representing the average expected profit of investment options chosen under each treatment, relative to the control group (represented by the coefficient on the constant). Standard errors are clustered at the individual level and are reported in parentheses below each coefficient estimate. *** p<0.001, ** p<0.05, * p<0.10. Panel (b) presents the results from the heterogeneity analysis graphically, with each point indicating the *total* risk taken under each treatment contract, with 90% confidence intervals shown around each point estimate.

of equity contracts on risk-taking was expected to be most significant for those with greater risk-aversion, while tailing off for those who were most risk-averse, and results in this section are consistent with that prediction.

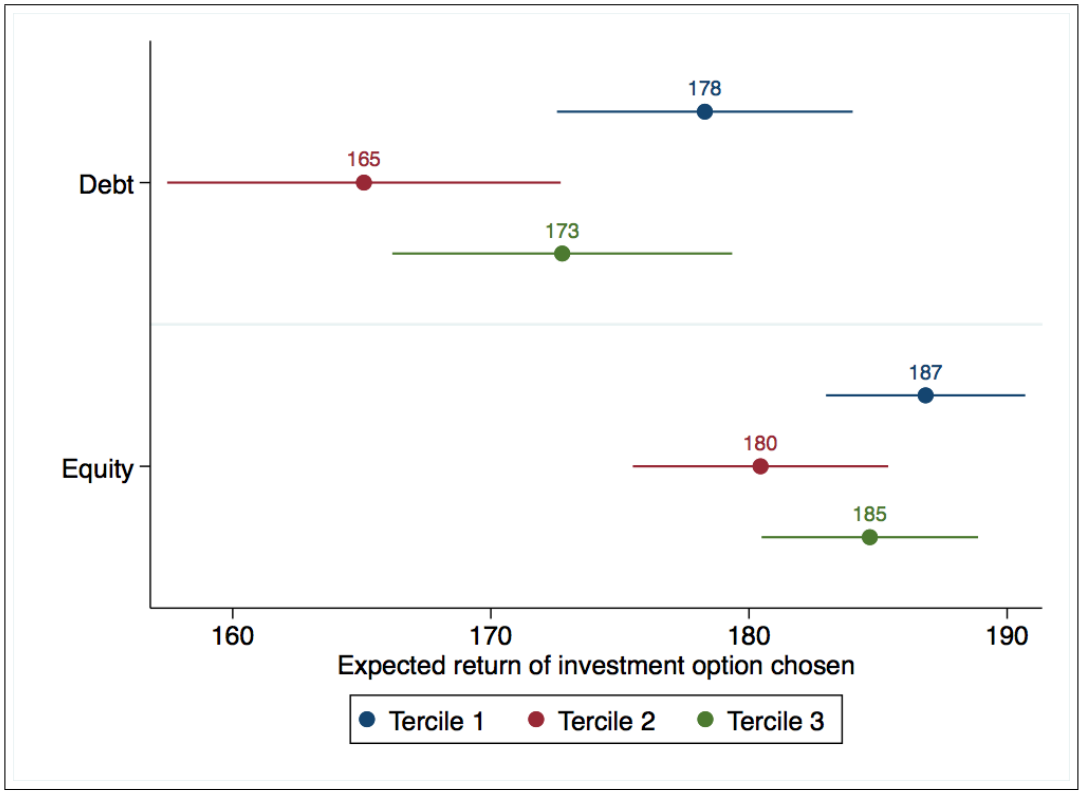
4.2.2 Loss-aversion

Entrepreneurs who are more loss-averse may take relatively less risk when financed by the debt contract, compared to the equity contract, because of the prospect of defaulting on their debt contract and having money deducted from the fixed participation fee that they are guaranteed for attending the workshop. Loss-averse agents may be more willing to choose a higher expected return but riskier investment option when provided with the implicit insurance of the equity contract, which mitigates the risk that they would lose some of their own wealth, compared to the unlimited-liability debt contract.

Table 5 presents regression and graphical analysis of results using the incentivised measure of loss-aversion. Column (1) presents results for the least loss-averse entrepreneurs, with column (2) containing results for those with an intermediate level of loss-aversion, and column (3) for the most loss-averse. In all specifications, the expected return of investment options chosen under equity is greater than that under debt. As can be seen graphically, the magnitude of the difference between risk-taking under equity compared to debt increases for those with an intermediate level of loss-aversion, compared to those who are the least lost averse. Specifically, for the least loss-averse group, risk taken under equity is 0.30 standard deviations greater than risk taken under debt, with the difference statistically significant at the 1% level. For those with an intermediate level of loss-aversion, risk taken under equity is 0.54 standard deviations greater than risk taken under debt, and significant at the 1% level. Finally, for the most loss-averse group, the effect size is smaller, at 0.42 standard deviations, significant at the 1% level, and mirroring the results for the incentivised risk-aversion measure in Table 4. The median split analysis of columns (4) and (5) reveals an effect size of 0.32 standard deviations for those with below-median loss-aversion and 0.49 standard deviations for those with above-median loss-aversion.

Table 5: Heterogeneity analysis: Loss-aversion

	(1) Tercile 1	(2) Tercile 2	(3) Tercile 3	(4) Below-median	(5) Above-median
ET	73***	72***	82***	72***	81***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
DT	64***	57***	70***	63***	66***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	114***	108***	103***	113***	103***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	1216	716	940	1604	1268
R-squared	0.25	0.24	0.30	0.25	0.28
ET vs DT (Percent)	4.8	9.3	6.9	5.2	8.3
ET vs DT (Standard deviation)	0.30	0.54	0.42	0.32	0.49
Test: ET = DT (p-value)	0.00	0.00	0.00	0.00	0.00



In all columns of the top panel, the dependent variable is the expected profit of the chosen investment option. Columns (1), (2) and (3) present results for the bottom, middle, and top terciles of the heterogeneity variable respectively. Columns (4) and (5) present results from the sub-sample with below- and above-median values respectively. ET and DT represent indicator variables for the equity and debt contracts respectively, with the reported coefficient estimate representing the average expected profit of investment options chosen under each treatment, relative to the control group (represented by the coefficient on the constant). Standard errors are clustered at the individual level and are reported in parentheses below each coefficient estimate. *** p<0.001, ** p<0.05, * p<0.10. Panel (b) presents the results from the heterogeneity analysis graphically, with each point indicating the *total* risk taken under each treatment contract, with 90% confidence intervals shown around each point estimate.

Analysing the behaviour of the most loss-averse microenterprise owners (the top tercile of loss-aversion) sheds light on why the effect is smaller relative to those with an intermediate amount of loss-aversion, as was clear in the analysis of the most risk-averse tercile in the incentivised risk measure. Individuals in the most loss-averse tercile made an average of 9 rejection decisions, meaning that they rejected investment options that involved either winning PKR 1,000 with probability 0.5 or losing PKR 200 with probability 0.5 (an expected value of 400), and 8 other similar investment options that led to winning PKR 1,000 or losing amounts greater than PKR 200 (in increments of PKR 100). As a comparison, the least loss-averse individuals only rejected 4 of the 10 investment options. Therefore, those in the most loss-averse tercile could be considered to have quite an 'extreme' amount of loss-aversion, as was the case with those in the top tercile of the incentivised risk-aversion activity; in fact, the correlation between responses in the incentivised loss-aversion activity and the incentivised risk preference elicitation activity is actually higher than that between the two risk preference activities (a correlation of 0.302 in the raw data, and 0.319 for the trichotomised measure, both statistically significant at the 1% level).

4.3 Heterogeneous effects: Management practices and education

The purpose of the first section of heterogeneity analysis was to explore heterogeneous treatment effects by variables that illustrate potential mechanisms through which the structure of contracts may affect investment behaviour. Results in Section 4.2 reveal that more risk-averse and more loss-averse individuals chose investment options with a greater expected return under equity financing than under debt financing. While there could be positive welfare effects in stimulating profitable investments for individuals whose behavioural characteristics lead them to relatively under-invest, from a policy perspective MFIs may not wish to provide such financing if those individuals have the worst business management practices, and the lowest education and cognitive ability. In this section I conduct a similar heterogeneity analysis for those variables, and confirm that such a concern is unfounded; there is no evidence that the microenterprise owners with the lowest business management practices, education or cognitive ability are those for whom equity contracts are incentivising the greatest risk-taking relative to debt; in fact, there is some evidence of the opposite effect.

4.3.1 Management practices

From a policy perspective, it is important to understand what the treatment effect is for microenterprise owners with better management practices, for example record-keeping and a clear separation of business and household finances. Equity financing, which requires accurate reporting of performance for the purposes of profit- and loss- sharing, is less viable for individuals who do not keep records of their assets, incomes and expenses, or who frequently combine business and household accounts. If individuals with better management practices take more risk under equity financing, this provides promising evidence for the potential impact of an equity-based product in the field. A recent literature has highlighted the importance of business management practices for performance of firms in developed countries (Bloom and Van Reenen, 2010). McKenzie and Woodruff (2016) develop a set of questions that have been adapted for microenterprises in a developing country setting, which I used to measure business management practices for the participants in my sample. The questions covered the following areas:

(i) Marketing (whether the firm advertises, attempts to attract customers with a special offer, and if it solicits customer feedback on what other products they would like it to sell);

(ii) Record-keeping (whether the firm records its sales and purchases, if it has calculated the cost and profit margin of its main products, and whether it has a written budget);

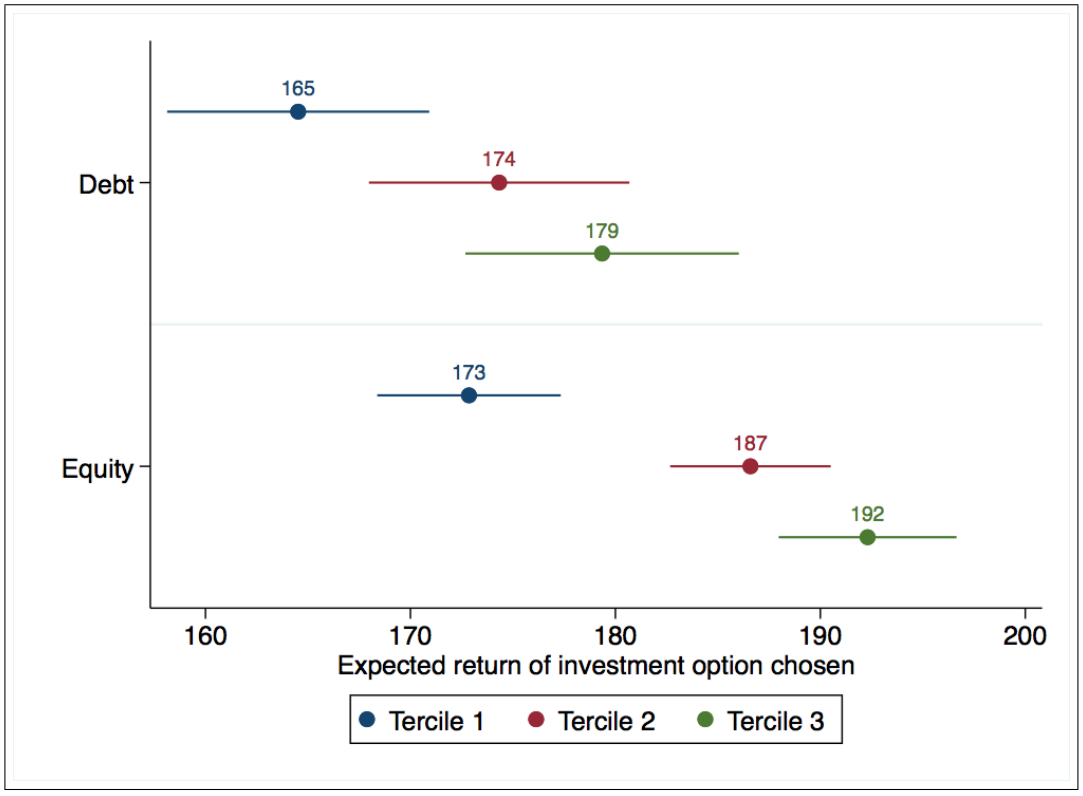
(iii) Financial planning (whether the firm has a sales target, and if it keeps a balance sheet and profit and loss statement);

(iv) Buying and stock control (whether it frequently runs out of stock, and if it attempts to negotiate with suppliers).

I aggregated all positive responses into a business management practices index. Results in Table 6 reveal that, as with all previous specifications, average risk-taking is greater under equity than debt for each sub-group. It can also be observed that the size of the effect is increasing for those with higher management practices; those in the lowest tercile of management practices take 0.29 standard deviations greater risk under equity (significant at the 5% level), with an effect size of 0.43 standard deviations for those with intermediate management practices and 0.45 standard deviations for the highest management practices group (both significant at the 1% level). A similar result is reflected in the median-split analysis (0.33 and 0.46

Table 6: Heterogeneity analysis: Business management practices

	(1) Tercile 1	(2) Tercile 2	(3) Tercile 3	(4) Below-median	(5) Above-median
ET	62***	79***	84***	70***	81***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
DT	54***	66***	71***	61***	68***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	111***	108***	108***	110***	108***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	840	1044	988	1412	1460
R-squared	0.21	0.29	0.29	0.25	0.28
ET vs DT (Percent)	5.1	7.0	7.2	5.6	7.5
ET vs DT (Standard deviation)	0.29	0.43	0.45	0.33	0.46
Test: ET = DT (p-value)	0.01	0.00	0.00	0.00	0.00



In all columns of the top panel, the dependent variable is the expected profit of the chosen investment option. Columns (1), (2) and (3) present results for the bottom, middle, and top terciles of the heterogeneity variable respectively. Columns (4) and (5) present results from the sub-sample with below- and above-median values respectively. ET and DT represent indicator variables for the equity and debt contracts respectively, with the reported coefficient estimate representing the average expected profit of investment options chosen under each treatment, relative to the control group (represented by the coefficient on the constant). Standard errors are clustered at the individual level and are reported in parentheses below each coefficient estimate. *** p<0.001, ** p<0.05, * p<0.10. Panel (b) presents the results from the heterogeneity analysis graphically, with each point indicating the *total* risk taken under each treatment contract, with 90% confidence intervals shown around each point estimate.

standard deviation effect sizes for those with below-median and above-median management practices respectively, with both effects significant at the 1% level). Overall, results are promising because they indicate that equity contracts had the greatest impact on risk-taking for those microenterprise owners with the best management practices.

4.3.2 Education and cognitive ability

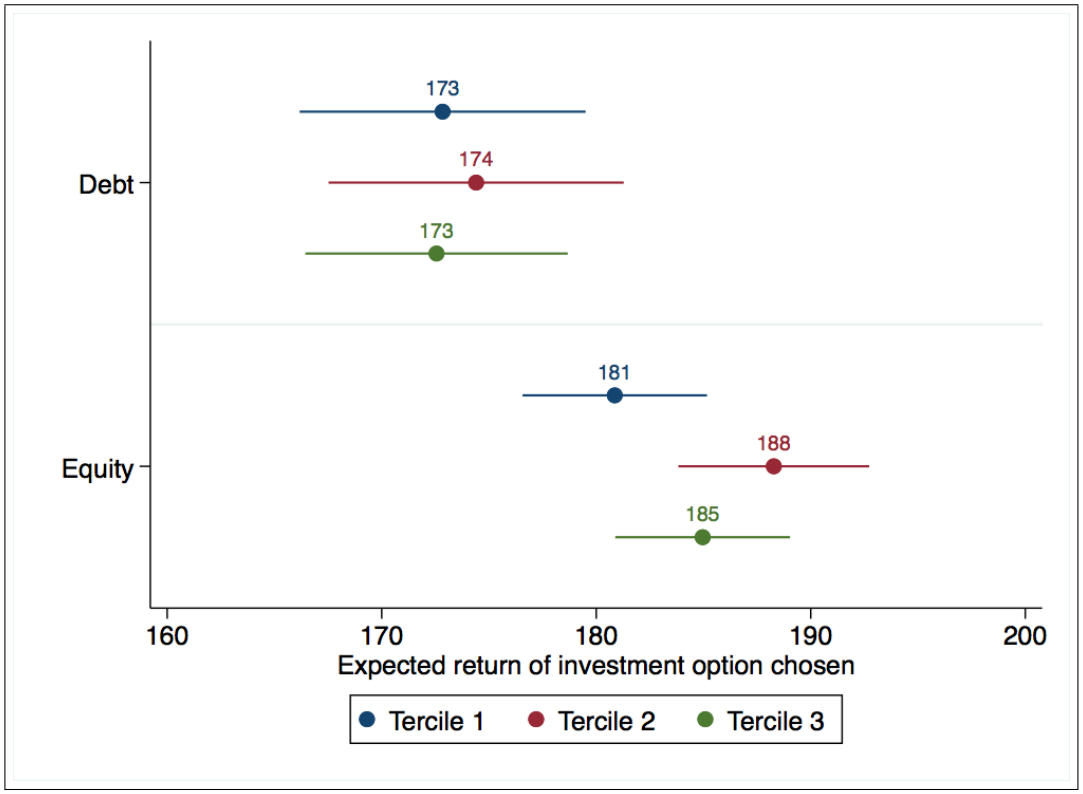
Equity contracts may be relatively unfamiliar to many participants and need more cognitive processing than simple fixed-repayment debt contracts, since they require individuals to calculate income-sharing payments of 25%, 50% and 75%. Individuals with lower cognitive ability may struggle with such calculations. While the education variable was simply measured as the highest completed level of formal education, cognitive ability was measured using a set of number recall activities and addition, subtraction and division questions, with scores aggregated into an index.

Tables 7 and 8 provide evidence that the largest effect of equity financing was amongst those with the highest education and cognitive ability respectively. Individuals in the lowest tercile of education took 0.28 standard deviations greater risk under equity, with an effect size of 0.48 and 0.43 standard deviations for those with intermediate and the highest levels of education respectively. Similar evidence is provided using scores from a mathematical test that was administered with all participants during the workshop, with an effect size of 0.30 standard deviations for the lowest tercile of maths score, and 0.45 and 0.42 standard deviations for those with intermediate and the highest maths scores respectively, with the effects statistically significant in all specifications.

Overall, results from this section of heterogeneity analysis provide encouraging evidence from a policy perspective that the greatest effect of equity contracts was on those microenterprise owners who had the highest education, cognitive ability and management practices. These individuals are those to whom MFIs may be most willing to offer equity-based products, since such contracts involve keeping records, separating household and business accounts, and making non-standard calculations for profit shares.

Table 7: Heterogeneity analysis: Years of education

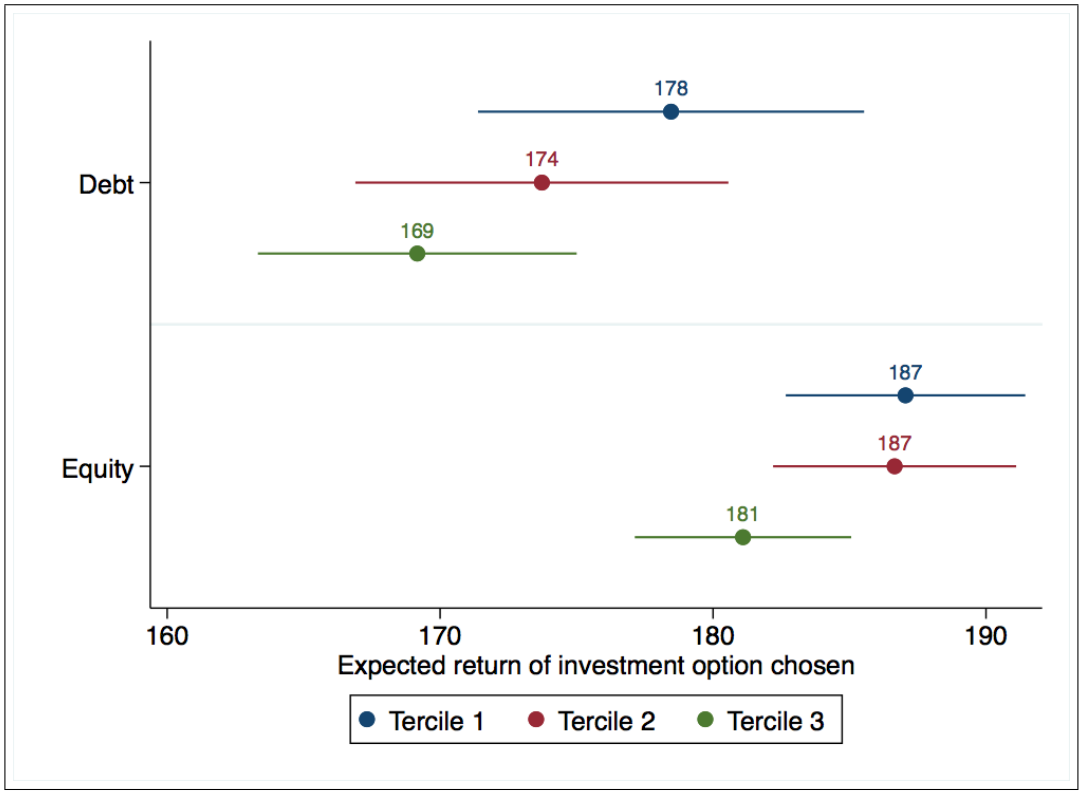
	(1) Tercile 1	(2) Tercile 2	(3) Tercile 3	(4) Below-median	(5) Above-median
ET	72***	80***	76***	76***	76***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
DT	64***	66***	63***	65***	63***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	109***	108***	109***	109***	109***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	972	836	1064	1628	1244
R-squared	0.24	0.30	0.26	0.27	0.26
ET vs DT (Percent)	4.6	8.0	7.2	6.0	7.3
ET vs DT (Standard deviation)	0.28	0.48	0.43	0.36	0.44
Test: ET = DT (p-value)	0.02	0.00	0.00	0.00	0.00



In all columns of the top panel, the dependent variable is the expected profit of the chosen investment option. Columns (1), (2) and (3) present results for the bottom, middle, and top terciles of the heterogeneity variable respectively. Columns (4) and (5) present results from the sub-sample with below- and above-median values respectively. ET and DT represent indicator variables for the equity and debt contracts respectively, with the reported coefficient estimate representing the average expected profit of investment options chosen under each treatment, relative to the control group (represented by the coefficient on the constant). Standard errors are clustered at the individual level and are reported in parentheses below each coefficient estimate. *** p<0.001, ** p<0.05, * p<0.10. Panel (b) presents the results from the heterogeneity analysis graphically, with each point indicating the *total* risk taken under each treatment contract, with 90% confidence intervals shown around each point estimate.

Table 8: Heterogeneity analysis: Mathematical calculations exercise

	(1) Tercile 1	(2) Tercile 2	(3) Tercile 3	(4) Below-median	(5) Above-median
ET	82***	79***	69***	79***	73***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
DT	73***	66***	57***	69***	61***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	105***	107***	112***	106***	111***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	780	944	1148	1268	1604
R-squared	0.32	0.27	0.22	0.28	0.25
ET vs DT (Percent)	4.8	7.4	7.1	5.8	7.2
ET vs DT (Standard deviation)	0.30	0.45	0.42	0.35	0.43
Test: ET = DT (p-value)	0.03	0.00	0.00	0.00	0.00



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4.3.3 Trust

The final pre-specified variable for heterogeneity analysis is trust. Trust is potentially quite important in the comparison between equity contracts, which involve sharing of profits and losses, and fixed-repayment debt contracts. Since individuals who are less trusting may be less inclined to choose equity financing in the field, understanding the treatment effect for more trusting individuals is important from a policy perspective. Trust was measured using a series of questions from the General Social Survey (GSS).[33] Table 9, as with all previous tables, shows greater risk-taking under equity compared to debt, for all terciles. The magnitude of the effect is 0.21 standard deviations for the least trusting, 0.40 standard deviations for those with an intermediate level of trust, and 0.52 standard deviations for the most trusting.

4.4 Robustness checks

As seen in Table 2 and the subsequent heterogeneity analysis of Tables 3 - 9, risk-taking under equity was greater than that under debt, with the effect evident in every sub-group used in the heterogeneity analysis. While this provides strong evidence for the effects, in this section I present further robustness checks by investigating second-round decisions and order effects.

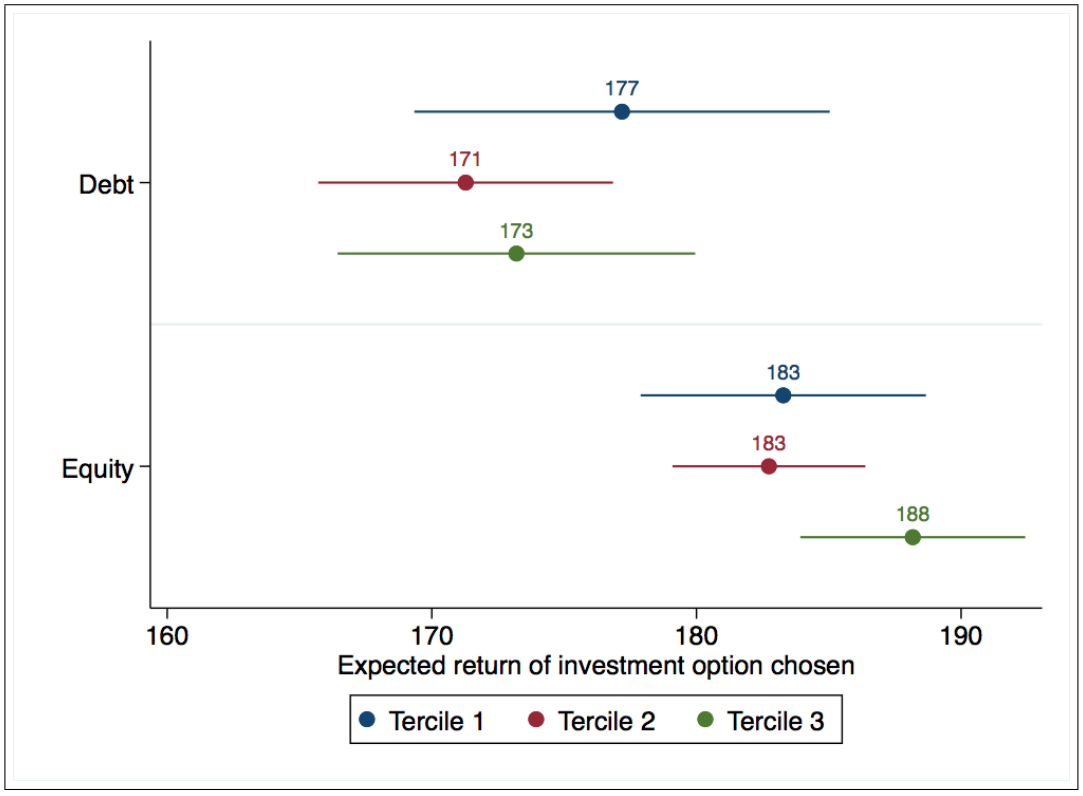
4.4.1 Second-round decisions

Table 10 illustrates results for the investment options chosen in the second decision round, using the strategy method described in Section 3.4. In columns (1) and (2) the analysis is done for second-round decisions conditional on a bad outcome occurring in the first round, and in columns (3) and (4) the analysis is done conditional on a good outcome having occurred in the first round. Columns (1) and (3) present results from specifications with simple treatment dummies and a dummy for basic order effects, while columns (2) and (4) include dummies that fully control for the endogeneity that is inherent in columns (1) and (3). Decisions in the second round are endogenous to the previous investment decision made by participants, which in this setting can be fully controlled for by including dummies for the decision made in the first round.

[33] As used by Giné, Jakiela, Karlan, and Morduch (2010).

Table 9: Heterogeneity analysis: Trust

	(1) Tercile 1	(2) Tercile 2	(3) Tercile 3	(4) Below-median	(5) Above-median
ET	75***	75***	78***	75***	76***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
DT	68***	63***	63***	67***	62***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	109***	108***	110***	106***	111***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	640	1344	888	1336	1536
R-squared	0.26	0.26	0.28	0.27	0.26
ET vs DT (Percent)	3.4	6.7	8.6	4.9	8.0
ET vs DT (Standard deviation)	0.21	0.40	0.52	0.30	0.48
Test: ET = DT (p-value)	0.11	0.00	0.00	0.00	0.00



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Column (1) reveals that in the second round, conditional on a bad outcome occurring in the first round, risk-taking under equity was 0.40 standard deviations greater than risk-taking under debt, with the difference statistically significant at the 1% level. Inclusion of dummies for endogenous selection does not significantly change the outcome; column (2) shows that equity-financed microenterprise owners took 0.29 standard deviations greater risk than those who were debt-financed, with the effect still statistically significant at the 1% level.

Table 10: Second-round decisions.

	(1) R2|R1bad	(2) R2|R1bad	(3) R2|R1good	(4) R2|R1good
Constant	77***	44***	176***	110***
	(0.00)	(0.00)	(0.00)	(0.00)
DT	65***	52***	24***	-14***
	(0.00)	(0.00)	(0.00)	(0.00)
ET	75***	59***	32***	-13***
	(0.00)	(0.00)	(0.00)	(0.00)
Order	0	0	1	-1
	(0.87)	(1.00)	(0.84)	(0.72)
R1:Inv2		37***		65***
		(0.00)		(0.00)
R1:Inv3		37***		94***
		(0.00)		(0.00)
R1:Inv4		64***		125***
		(0.00)		(0.00)
R1:Inv5		60***		148***
		(0.00)		(0.00)
Observations	2872	2872	2872	2872
R-squared	0.34	0.41	0.05	0.37
ET vs DT (Percent)	7.2	7.7	3.9	0.6
ET vs DT (Standard deviation)	0.40	0.29	0.14	0.01
Test: ET = DT (p-value)	0.00	0.00	0.00	0.71

While column (3) also reveals greater risk-taking under equity in the second decision round conditional on a good outcome occurring in the first round, with an effect size of 0.14 standard deviations (significant at the 1% level), inclusion of dummies for first-round decisions leads to this effect almost completely disappearing (to 0.01 standard deviations, statistically indistinguishable from zero). In fact, inclusion of the first-round dummies reveals that the coefficients on the debt and equity treatments are actually negative and of similar magnitude, implying less risk-taking relative to the control group. This could indicate an income effect, whereby entrepreneurs who were externally financed, by either debt or equity, are implicitly being taxed

on their gains, with some portion being returned either as a loan repayment or an equity sharing amount, whereas the control group accrue the full additional benefits of the positive investment outcomes.

4.4.2 Order effects

As described in Section 3, the experiment used a within-subject design, where each microenterprise owner made investment decisions under all treatments, with the order of the financing treatments randomised. Column (1) of Table 11 presents regression analysis with the same simple controls for order effects as in previous regressions, as well as the addition of interaction terms between the order and treatments, where 'Order' is an indicator variable for whether debt (randomly) appeared as the first treatment. Column (2) illustrates the analysis for only those observations where debt was randomly revealed first, and column (3) displays results when equity appeared first. Risk-taking under equity is significantly greater than risk-taking under debt, regardless of whether debt or equity appear first, although there is some difference in magnitude. Column (3) reveals that when equity appeared first, risk-taking under equity was greater by 0.53 standard deviations, significant at the 1% level. The effect decreases to 0.25 standard deviations greater risk-taking under equity when debt appears first, but is still highly significant (p-value 0.010). As can be seen in columns (2) and (3), risk-taking under equity is at approximately the same level regardless of whether debt or equity appear first in the order, however risk-taking under debt is lower when it appears after equity. One possible interpretation is that, having experienced the risk-sharing contract, individuals are subsequently less likely to take risk under debt as they have learned about the insurance-like benefits of the equity contract, which are absent from a fixed-repayment loan contract. Nonetheless, as mentioned, risk-taking under equity is still significantly greater than risk-taking under debt, even when debt appears first.

Table 11: Order effects.

	(1) ExpRet	(2) ExpRet	(3) ExpRet
Constant	109***	108***	109***
	(0.00)	(0.00)	(0.00)
DT	59***	70***	59***
	(0.00)	(0.00)	(0.00)
ET	75***	77***	75***
	(0.00)	(0.00)	(0.00)
Order	-1		
	(0.61)		
DT:Ord1	10**		
	(0.03)		
ET:Ord1	2		
	(0.62)		
Observations	2872	1412	1460
R-squared	0.27	0.28	0.25
ET vs DT (Percent)		4.1	9.1
ET vs DT (Standard deviation)		0.25	0.53
Test: ET = DT (p-value)		0.01	0.00

4.4.3 LASSO

In this section, I use a simple machine learning technique as a robustness check for the heterogeneity analysis of Sections 4.2 and 4.3. Specifically, the Least Absolute Shrinkage and Selection Operator (LASSO) and Post-LASSO estimator proposed by Belloni, Chernozhukov, and Hansen (2014) is employed. The Post-LASSO estimator (and other high-dimensional model selection methods) can be a useful forecasting tool when there are a large number of potentially informative covariates. For a simple model:

$$y_i = \sum_{j=1}^{p} \beta_j x_{ij} + u_i$$

LASSO coefficients are chosen to minimise the sum of squared residuals plus a penalty term that penalises the size of the model through the sum of absolute values of the coefficients:

$$\widehat{\beta} = \arg\min_{b} \sum_{i=1}^{n} \left(y_i - \sum_{j=1}^{p} x_{ij} b_j \right)^2 + \lambda \sum_{j=1}^{p} |b_j| \gamma_j$$

where λ is a penalty parameter and γ_j are penalty loadings. One issue with this estimator is that non-zero coefficients that are part of the solution to the LASSO problem tend to be biased towards zero. The Post-LASSO estimator first applies LASSO to determine which variables can be dropped from the standpoint of prediction, and then estimates coefficients on the remaining variables using ordinary least squares. Table 12 presents results from LASSO estimation. In the top panel, all variables that were used for the purposes of heterogeneity analysis in Sections 4.2 and 4.3 are included in their trichotomised form. In the bottom panel, I also add a number of other potentially important business and household characteristics: business revenues and profits, business fixed assets and current assets, household income and expenditure, and household assets, savings and loans. Column (1) presents results from the initial LASSO estimation, and column (2) displays Post-LASSO coefficients.

Unsurprisingly, LASSO estimation identifies the two most important variables for predicting the outcome variable of expected return of investment chosen as the debt and equity treatment indicator variables, DT and ET. The top panel also identifies risk-aversion and loss-aversion as important variables for predicting risk taking, independently of their interaction with the treatment variables. Both coefficients are negative, indicating that more risk- and loss-averse microenterprise owners chose investment options with a lower expected return and risk, on average. Results also confirm the findings of Section 4.2: more risk-averse individuals chose investment options with a higher expected return when financed with the equity contract, as indicated by the selection of the interaction between ET and the two different measures of risk-aversion in the LASSO estimation (specifically, the third tercile of risk-aversion for the survey-based measure, and the second tercile of risk-aversion for the incentivised measure). In contrast, LASSO dropped the interaction between DT and risk-aversion measures. Further, in the top panel, the LASSO specification also selected the interaction between ET and the top two terciles of management practices, as well as the top tercile of the trust measure, with a positive coefficient indicating greatest risk-taking when individuals with the highest management practices and the highest level of trust are equity-financed. The only debt-interacted variable selected in the top panel is the interaction between DT and the top tercile of management practices.

Table 12: LASSO

Selected variables	(1) LASSO	(2) Post-LASSO
ET	58.08	59.05
DT	49.04	61.09
Risk (incentivised) tericle 3	-1.43	-7.68
Loss aversion tericle 2	-0.01	-6.80
ET * Risk (incentivised) tercile 2	0.89	1.57
ET * Risk (survey-based) tercile 3	2.25	8.73
ET * Management practices tercile 2	3.15	13.71
ET * Management practices tercile 3	8.07	19.25
ET * Trust tercile 3	0.57	5.89
DT * Management practices tercile 3	2.41	9.67

Selected variables	(1) LASSO	(2) Post-LASSO
ET	55.77	49.79
DT	44.83	52.94
Risk (incentivised) tericle 3	-1.23	-7.99
Household savings tericle 2	-3.67	-8.65
ET * Risk (incentivised) tercile 2	1.26	1.91
ET * Risk (survey-based) tercile 3	1.92	8.61
ET * Management practices tercile 2	2.13	11.42
ET * Management practices tercile 3	6.09	12.84
ET * Trust tercile 3	0.39	6.37
ET * Household expenditure tercile 3	1.19	4.40
ET * Household assets tercile 2	0.57	6.09
ET * Business total fixed assets tercile 3	2.45	5.88
ET * Business total current assets tercile 2	3.13	11.46
ET * Business total current assets tercile 3	1.09	8.32
DT * Management practices tercile 3	2.09	9.22
DT * Business total fixed assets tercile 2	5.19	12.45
DT * Business total current assets tercile 2	5.74	12.23

The top panel presents results from a LASSO and Post-LASSO estimation using all variables that were used for heterogeneity analysis in Sections 4.2 and 4.3, in their trichotomised form. The dependent variable is the expected profit of the chosen investment option. In the bottom panel, a number of other potentially important variables are added in their trichotomised form: business revenues and profits, business fixed assets and current assets, household income and expenditure, and household assets, savings and loans.

Results in the bottom panel, when including a number of other business and household characteristics, reveal the robustness of the findings in the top panel; the LASSO estimator continues to select the interaction between equity financing and risk-aversion, management practices and trust as important variables in predicting the outcome variable. Further, a number of other variables that capture business size and household wealth are also found to be important determinants of risk-taking when interacted with both treatment variables (with the majority of the selected variables being those interacted with the equity financing indicator). As discussed by Mullainathan and Spiess (2017), the purpose of LASSO and other machine learning algorithms is prediction and not parameter estimation, so one should be cautious in providing too much interpretation to these results. The purpose of this section was to provide an additional robustness check, which confirms the importance of risk-aversion when interacted with equity financing. However, the fact that loss-aversion was dropped by the LASSO estimator does not indicate that loss-aversion is not an important factor; it could simply be that risk-aversion is more accurately measured than loss-aversion in the behavioural games activities, which would not be surprising, given that there were many more questions dedicated to measuring risk preferences.

5 Implementing microequity contracts in the field

Results in Section 4 reveal that equity contracts led to greater risk-taking compared to debt-based contracts, and that the effect was particularly strong for the more risk-averse and loss-averse entrepreneurs, who might ordinarily under-invest. Further, the second part of the heterogeneity analysis provides evidence that mitigates adverse-selection-type concerns that those microenterprise owners who are most encouraged to take more risk with equity financing might be those with the worst business management practices, education and cognitive ability, which has important implications for the viability of implementing equity contracts in the field. Given the positive results, it is important to investigate why we do not typically observe MFIs implementing microequity contracts in the field. The majority of microcredit contracts have a very rigid structure, and – although there are recent researcher-led efforts to introduce more flexible microcredit contracts – to my knowledge there is no organisation that is implementing performance-contingent-repayment contracts with microenterprises on any meaningfully large scale. Theoretical work suggests that equity contracts are non-optimal relative to debt due to costly state verification (Townsend, 1979) and moral hazard (Stiglitz and Weiss, 1981), although those results only hold for a risk-neutral agent and a fixed-repayment contract may be

sub-optimal for a risk-averse agent. Given many MFIs' stated objectives to prioritise borrower welfare as well as profits, it is peculiar that no large MFI is implementing microequity contracts, given the potential benefits discussed in the artefactual field experiment in this paper, in particular for individuals whose behavioural characteristics such as risk- and loss-aversion may lead them to under-invest. In this section, I provide some evidence that sheds light on some of the most important constraints to implementing microequity contracts in the field, using a survey that I designed to investigate a microequity program that had been initiated by one of the largest microfinance institutions in Pakistan, the National Rural Support Programme (NRSP).[34]

NRSP is the largest rural support programme in Pakistan, with a presence in 64 districts across all four provinces, and currently working with 3 million poor households. In September 2014, NRSP launched a microequity program that aimed to help skilled apprentices start their own business by providing them with equity-like capital. As of August 2015, 1,250 individuals had been provided with financing as part of this program, in five major districts across Punjab and Islamabad.[35] I generated a stratified random sample from the population of 1,250 clients, based on the following variables: (i) gender; (ii) business type (trade, manufacturing or services); (iii) district; and (iv) age of entrepreneur (using a median-split). This generated 60 distinct blocks, from which a random sample of 248 individuals was drawn.[36]

5.1 Summary statistics

Tables 13 and 14 present summary statistics. 90% of clients were male, with a mean age of 33. The average years of education was eight, and 95% of clients could read Urdu. 73% of clients were married, and the average household size was approximately seven. 96% of respondents were managing a business, with 88% of them only running one business (79% owned that business themselves). On average, they had seven years of experience in the sector to which their business related (either managing a business, or as an apprentice). 81% of businesses were initially set up by the respondent. 61% of businesses had no other employees, with 20% having one additional employee and 12% having two additional employees. Only 2% of respondents

[34] I learned about this program in the course of fieldwork for the artefactual field experiment; the program had started before my activities with Akhuwat and I was invited by the CEO of NRSP to conduct a survey to evaluate the implementation of these microequity contracts in the field.
[35] In Attock, Chakwal, ICT, Jhelum, and Mandi Bahauddin.
[36] All surveys were then conducted by enumerators at the microenterprise's location of business.

had any other form of wage employment.

Table 13: NRSP sample: Summary statistics

	count	mean	sd	min	max
Gender	248	0.10	0.31	0.00	1.00
Age	248	33.09	9.10	19.00	70.00
Education	248	8.16	3.19	0.00	14.00
Reads Urdu	248	0.95	0.42	0.00	2.00
Married	248	0.73	0.44	0.00	1.00
HH Size	248	6.88	3.37	2.00	32.00

In terms of sectoral composition, the most common business sectors were: (i) trade and retail shops; (ii) hairdressers and beauty parlours; (iii) tailors; (iv) food outlets; and (v) vehicle repair shops. Figure 11 in the Appendix illustrates business performance. The average microenterprise had mean monthly sales of PKR 81,000 (approximately $ 810) over the previous three months, with a median of $360, and mean monthly profits of $178 (median $136), which is not too dissimilar to the microenterprise clients of Akhuwat who took part in the artefactual field experiment.

Figure 12 in the Appendix shows that 68% of microenterprise owners were previously apprentices, which is unsurprising given that the program specifically aimed to help skilled but capital-constrained apprentices start a business. The mean number of years of experience as an apprentice was three. In terms of reasons for taking the financing product, approximately half of microentrepreneurs stated the purchase of assets or equipment for the business as one of the reasons, with 40% stating the purchase of raw materials. The amount of financing received as part of the program was $500 in 97% of cases, which is the first indication that the product, as it was implemented, appeared very similar to that of a conventional microcredit portfolio.

Table 14: NRSP sample: Business activities

	count	mean	sd	min	max
Manage a business?	248	0.96	0.19	0.00	1.00
Numbers of businesses managed	239	1.15	0.42	1.00	3.00
Own the business?	248	0.79	0.41	0.00	1.00
Number of years of experience (in sector)	239	6.57	6.70	0.00	50.00
Started the business from scratch?	248	0.81	0.39	0.00	1.00
Number of employees in the business	238	0.70	1.11	0.00	6.00
Own the land on which the business operates?	239	0.26	0.44	0.00	1.00
Have any form of other wage employment?	248	0.02	0.15	0.00	1.00

Given the heterogeneity in business sector and business performance observed in Figure 11, some variation in financing amount might have been expected.

5.2 NRSP contract structure

The main purpose of the survey was to investigate the structure of the contracts that were intended to be implemented as 'microequity', as described by clients who were provided with financing. Figures 8, 9 and 10 illustrate the results. It is clear that NRSP had started implementing the product as an equity-based contract, for which there was a pre-agreed profit- and loss-sharing ratio of 20-80 (with the entrepreneur sharing 20% of their monthly profits with NRSP, and keeping 80% for themselves). As observed in Figure 8, when asked what the 'profit-sharing ratio' was between them and NRSP, 50% of respondents answered "80-20", which reflects the actual profit- and loss-sharing ratio with which the program started. Over 30% of respondents, however, stated that they did not know the profit-sharing ratio; post-survey follow-up conversations with enumerators suggested a lack of comprehension of this question. In hindsight, this reflects many entrepreneurs' inability to understand a question about sharing ratios when the way in which the product was being implemented at the time of the survey very much resembled a conventional fixed-repayment debt product. The next graph in Figure 8 again provides evidence that the way the contracts were being implemented in the field at the time of the survey mirrored a conventional debt contract with one set of standard terms and conditions implemented by all NRSP field staff. Here, it is clear that the repayment payment frequency was monthly for all entrepreneurs. While this is not sufficient evidence in itself that the product being offered was not equity-like, *some* variation in payment frequency might have been expected if a true equity-like product was being implemented.

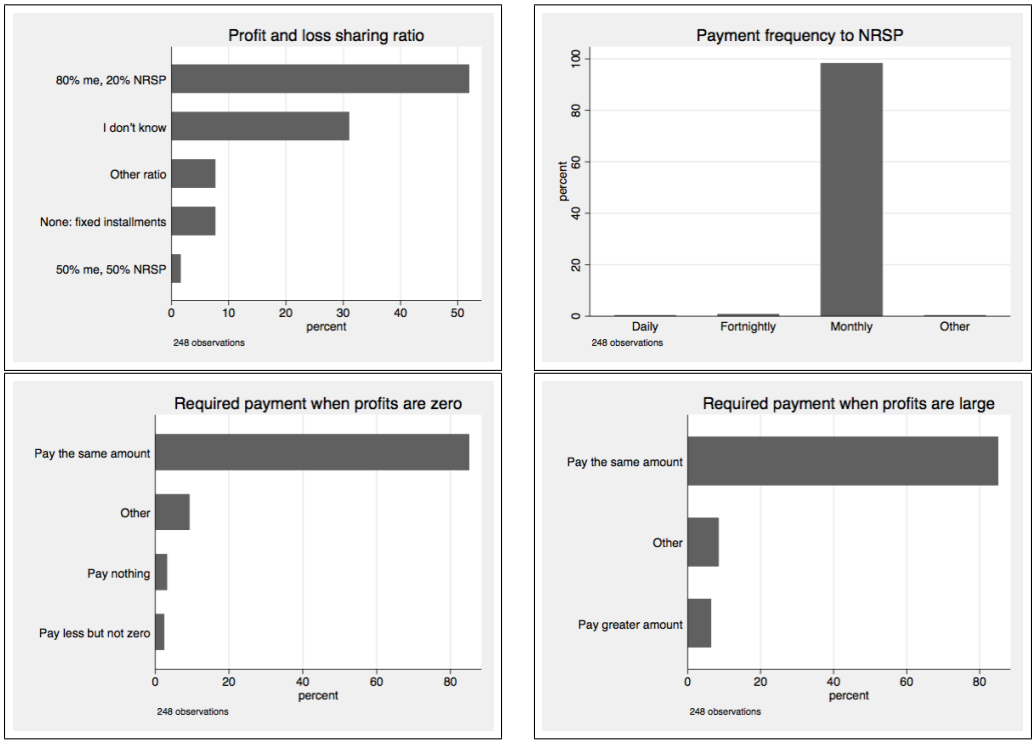
The next two questions were the most significant in the survey; if what was being implemented was truly an equity-like product with performance-contingent payments, then one would expect some correlation between microenterprise business outcomes and actual payments made to NRSP. The following questions were asked:

(i) *"Think about the current contract that you have with NRSP. If you have zero profits in a given period that you usually make payments, how much do you have to pay to NRSP?"*

(ii) *"Think about the current contract that you have with NRSP. If you have very big profits in a given period,*

how much do you have to pay to NRSP?"

Figure 8: Contract structure questions 1

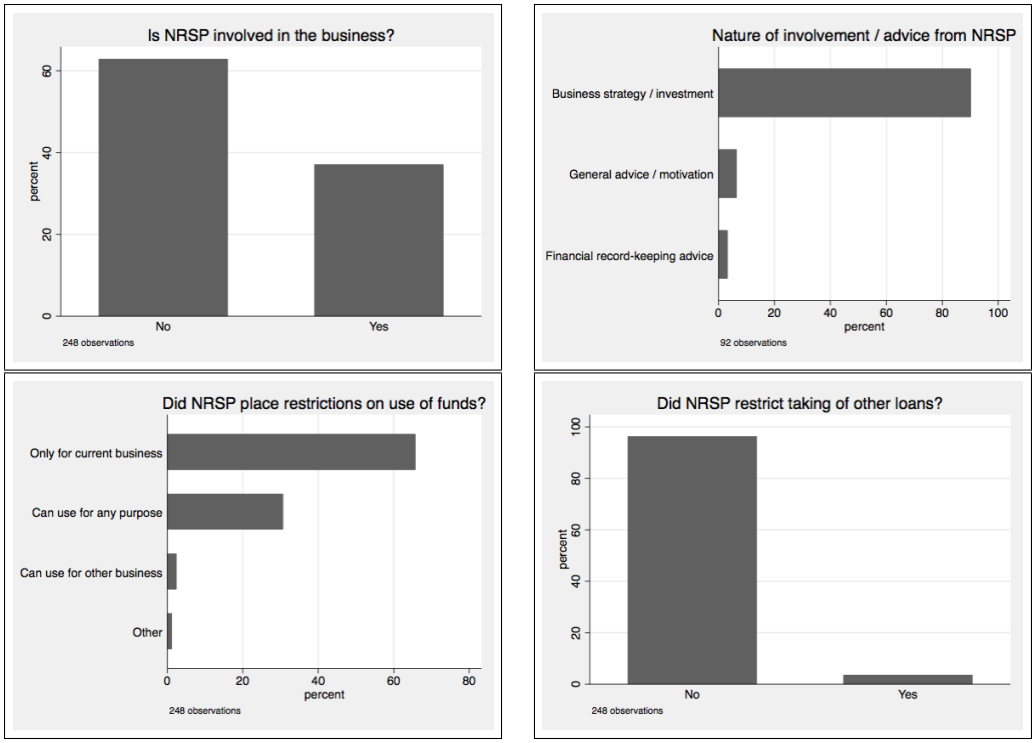


The results, illustrated in the third and fourth graphs in Figure 8, are very clear; in 85% of cases, the respondent stated that there was no profit- or loss-sharing involved in their relationship with NRSP: when their business profits were low, their repayments stayed the same, and when their business profits were high, their repayments again remained constant. This provides conclusive evidence that what was being implemented in the field was not equity-like in the sense of containing performance-contingent repayments.

Another common feature of equity contracts is active involvement by the capital provider in the business. The first and second panels in Figure 9 illustrate that 37% of microenterprise owners said that NRSP was involved in their business, with most people citing some sort of 'business / investment strategy' as the form of advice. To further explore the extent of the involvement of NRSP, the next two questions were posed: *"Does the financing place any restrictions on the type of business for which you can use the money?"* and *"Does the financing place any restrictions on you taking other loans in your business?"*. As can be seen in the third and

fourth panels of Figure 9, 65% of respondents stated that they *were* restricted to using the money for their current business, while 31% asserted that they could spend the money for any other uses (which is rather surprising, given that the program was solely intended for business financing). 96% of respondents stated that NRSP did not place any restrictions on them taking other loans in their business. This is likely to be a standard practice with conventional loans, but it may be a cause for concern when providing actual equity-like financing. Specifically, if providing a loss-sharing product, the hierarchy of claims on the cash-flows of the firm is important (with debt typically having seniority and equity representing the residual claimant), so an MFI offering equity-like financing might be advised to place restrictions on the amount of debt that the microentrepreneur takes on.

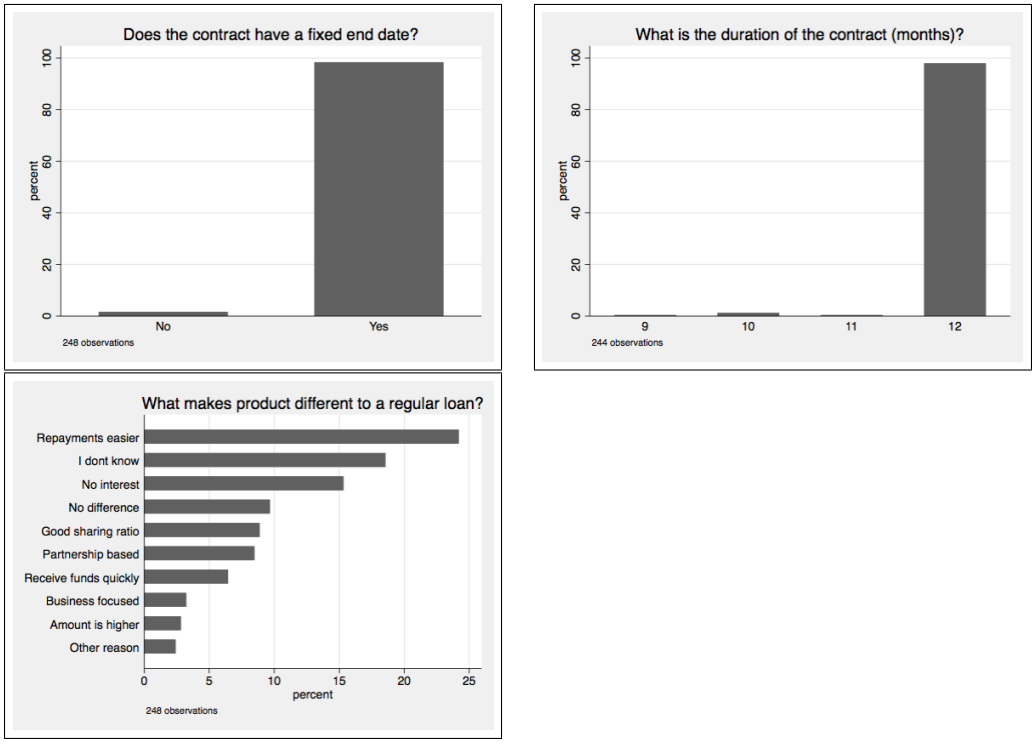
Figure 9: Contract structure questions 2



Finally, the first and second panels in Figure 10 illustrate that almost all contracts were implemented with a fixed end date of 12 months, much like the conventional NRSP loan product. The third panel illustrates the response to the question, *"In what ways is this product different from a normal loan?"*. There were many positive reasons given; approximately 30% stated that the payment terms were preferable, and nearly 10%

thought that it was more 'partnership-based'. 15% said that it was unique because it was not interest-based; this is a surprising result, since the product very much resembled a conventional interest-based product, which is NRSP's standard product. This response may reflect that the program did in fact start with an equity-based product, and initially used Islamic legal terms such as '*Musharakah*', which means joint participation in Arabic and is commonly used to describe equity financing. This likely also reflects the desire of many clients to use non-interest-based products. In summary, this section of questions provides conclusive evidence that the contracts, as they were being implemented in the field, did not contain any loss-sharing or profit-sharing features, and that NRSP was not exercising any control rights in the operational or financial management of the firm.

Figure 10: Contract structure questions 3



5.3 Discussion

Results from Section 5.2 reveal that, at the time of the survey, the contracts were not implemented in any meaningfully distinct way from a conventional fixed-repayment, fixed-duration, microcredit contract. Presen-

tation of results and a detailed focus group with senior managers and field officers revealed interesting reasons for which these contracts, which had in fact started with performance-contingent repayments, converged to a standard debt structure. Results relate to many of the themes that arise in earlier theoretical work on sharecropping and income-sharing contracts, which suggest the optimality of a standard debt contract in the presence of information asymmetries and costly state verification.[37]

I presented results from the survey to NRSP's CEO, senior management and regional managers, with a detailed focus-group-style discussion taking place over the course of three hours. There are two major insights arising out of post-survey reflections and accounts from managers and field officers. First, from the supply side, one valuable lesson is the difficulty in implementing equity-like contracts within the structure of a conventional microcredit organisation. Loan officers did not have much incentive to finance higher-return, higher-risk microenterprise owners by providing them with an unfamiliar product that required greater monitoring effort and contained loss-sharing, especially because the loan officer would not themselves benefit from the upside portion of the profit- and loss-sharing arrangement (i.e. they had no 'skin in the game'). Further, loan officers reported that it was very time-consuming to calculate profit- and loss-sharing amounts, since many microenterprises did not keep adequate income statements, thereby requiring the loan officer to essentially create these. Even when records were kept, they were often paper-based and took much time to process for calculating performance-contingent payments, which reinforces the idea that in a world of costly state verification, a non-performance-contingent contract may be optimal.

The second key lesson arising out of post-survey interviews was from the perspective of clients. Results indicate that many clients had serious objections to the sharing rule used in the contracts when they were originally implemented with profit- and loss-sharing. A common sharing rule led to the most profitable entrepreneurs having to share too much of their profits and thus the equity product, ironically, appearing to be very 'inequitable' to them. The post-survey focus group with NRSP management revealed that gradually this led to loan officers and clients mutually agreeing to remove the performance-contingent aspect of the contracts, which eventually converged to a fixed-repayment structure, albeit on much more lenient terms

[37] See Townsend (1979); Stiglitz and Weiss (1981).

than a conventional microcredit contract. Had NRSP maintained performance-contingent contracts alongside fixed-repayment contracts, adverse selection may have become a serious issue, with the most profitable microenterprises deciding to re-negotiate to a debt contract, and the least profitable ones remaining on performance-contingent contracts. Hence, the decision taken by NRSP management to revert all contracts back to a standard fixed repayment schedule appears to have been appropriate. This decision to move back to debt-like contracts also appears prudent in light of the potential adverse consequences of moral hazard. Since a 20-80 sharing ratio was considered inappropriate by some of the more profitable businesses, in that they were obliged to share too much of their profits, had NRSP not renegotiated the contract then it could have created negative incentives for those microenterprises stuck on 'unfair' sharing ratios. This may have encouraged them either to exert less effort – for instance if they equated their marginal disutility of effort with their share of their marginal product rather than total marginal product – or to simply understate their profits, which would be difficult to detect due to costly state verification.

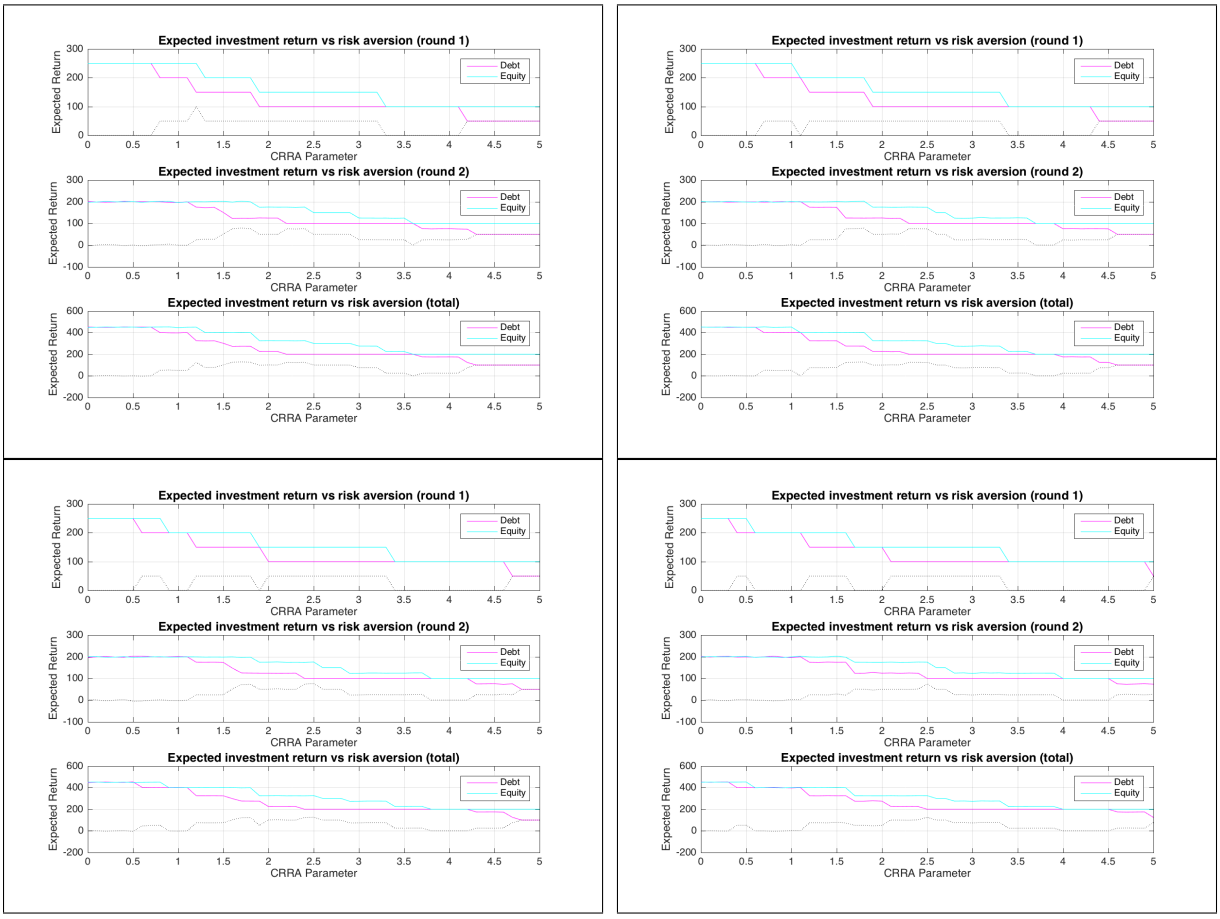
Intriguingly, NRSP branch managers also observed that, even though the contracts originally maintained a 'downside option' that did allow for loss-sharing ex-ante, in practice no entrepreneurs ever exercised this loss-sharing option. This was due to a fear that if they did not meet their expected payment every month, it would adversely affect their standing with the bank, which may hinder their ability to borrow in the future. Therefore, fears regarding reputation and dynamic incentives actually led to microenterprise owners not exercising their loss-sharing option, even when NRSP had explicitly allowed it. In summary, these findings from the survey of NRSP clients suggest that it is very challenging to implement equity-based contracts within a conventional microcredit organisation. The major constraints relate to the incentives of microcredit loan officers and those of clients, as discussed in earlier theoretical work on optimal financial contracts in the presence of asymmetric information and costly state verification. These are compounded by the related problems of adverse selection (the most profitable microenterprises selecting out of equity contracts) and moral hazard (distortionary effects caused by inappropriately chosen income-sharing ratios).

6 Conclusion

Access to finance is frequently listed as one of the most important constraints on the expansion of small firms in low-income countries. Many existing studies focus on the role of microcredit as a source of capital; other work complements this by considering the potential effect of microsavings and microinsurance. In this paper, I investigate the effect of 'microequity' contracts, which provide capital using a performance-contingent repayment schedule that allows a greater sharing of risk and reward between capital provider and microenterprise. In the first part of the paper, I describe the implementation of an artefactual field experiment, designed using a simple model of investment choice under different financial contracts, and tested with microenterprise owners who are part of a large field experiment that provides them with a graduated loan to expand their business with a fixed asset. Results reveal that equity-financed microentrepreneurs chose investment options with a greater expected return and risk than under debt financing, with heterogeneity analysis showing a larger effect for more risk- and loss-averse microenterprise owners. In the second part of the paper, I explore the question of why microequity contracts do not appear to be part of the current portfolio of products offered by most microfinance institutions, considering the significant potential benefits identified in the first part of the paper. To shed some light on this question, I report on an attempt by one of the largest microfinance institutions in Pakistan to implement equity-based microfinance contracts with microenterprise owners in the field. Results from a detailed client survey and a post-survey focus group with senior management point to the significant challenges of implementing equity-based contracts within a conventional microcredit organisation, with the major constraints relating both to the incentives for microcredit loan officers as well as costly state verification, adverse selection and moral hazard.

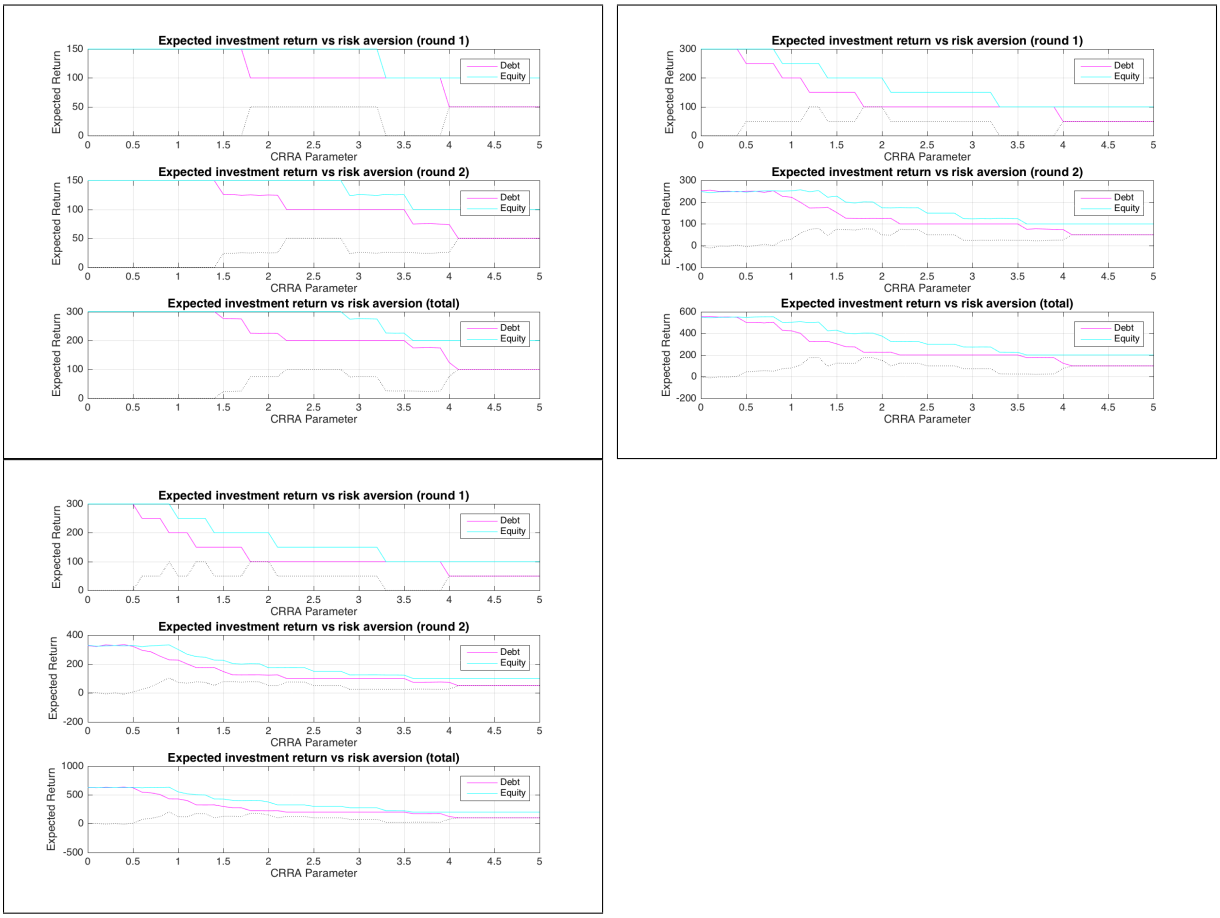
7 Appendix

Table 15: Simulations: Changing the number of game rounds.



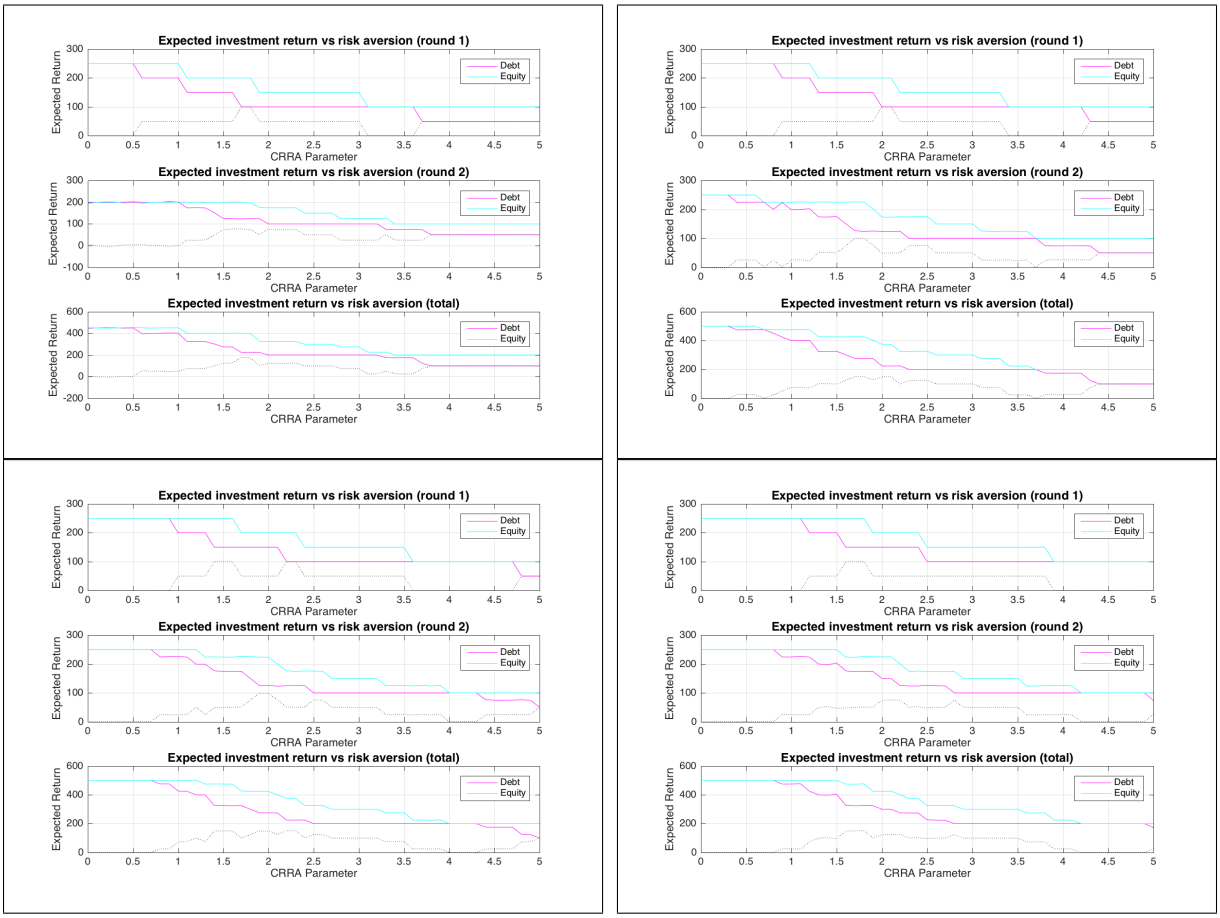
This figure presents results from simulations with a different number of investment rounds in the game: (beginning in the top-left panel, going clockwise): 3, 5, 7 and 10 rounds.

Table 16: Simulations: Changing the number of investment options.



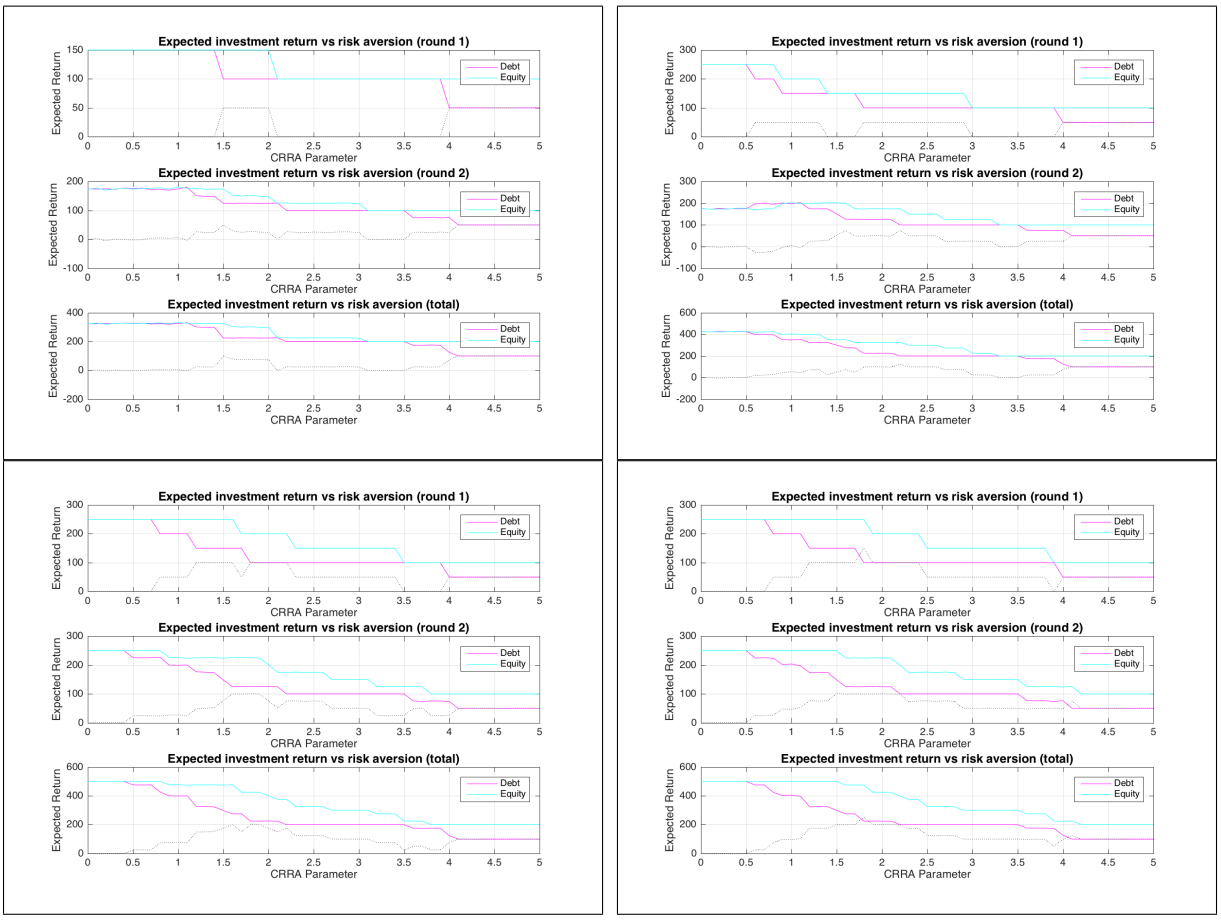
This figure presents results from simulations with a different number of investment options per round: (beginning in the top-left panel, going clockwise): 3, 7 and 10 investment options.

Table 17: Simulations: Changing the initial wealth level in the game.



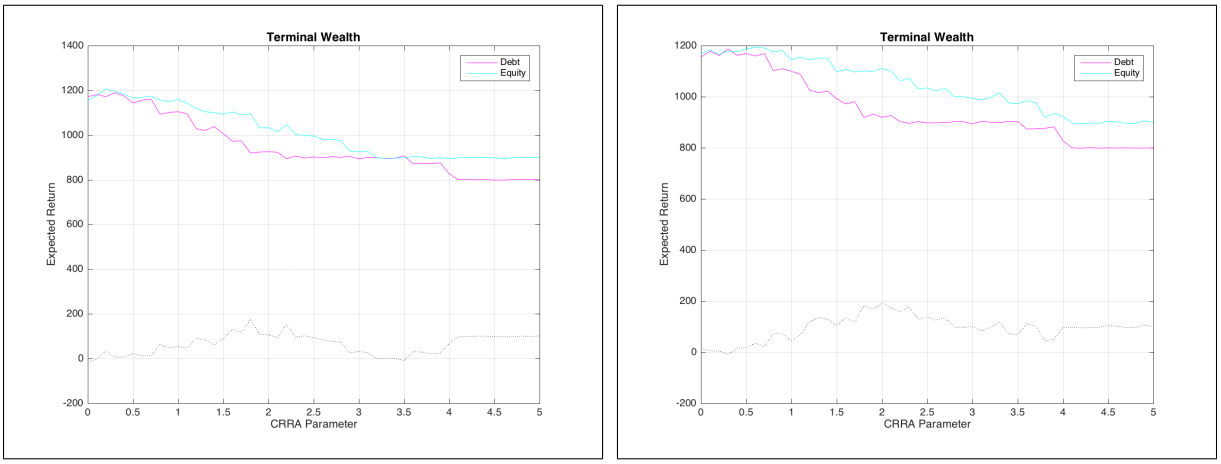
This figure presents results from simulations with a different starting amount of investment wealth in the first round of the game: (beginning in the top-left panel, going clockwise): 100, 300, 500, and 700.

Table 18: Simulations: Changing the financing amount.



This figure presents results from simulations with a different capital amount for the financing contracts: (beginning in the top-left panel, going clockwise): 100, 300, 700, and 1,000.

Table 19: Simulation: Terminal wealth at the end of the game.



This figure presents results for the terminal wealth for agents at the end of the game. The left panel represents the 50-50 equity contract, and the right panel the 25-75 equity contract.

Figure 11: Business Performance Metrics

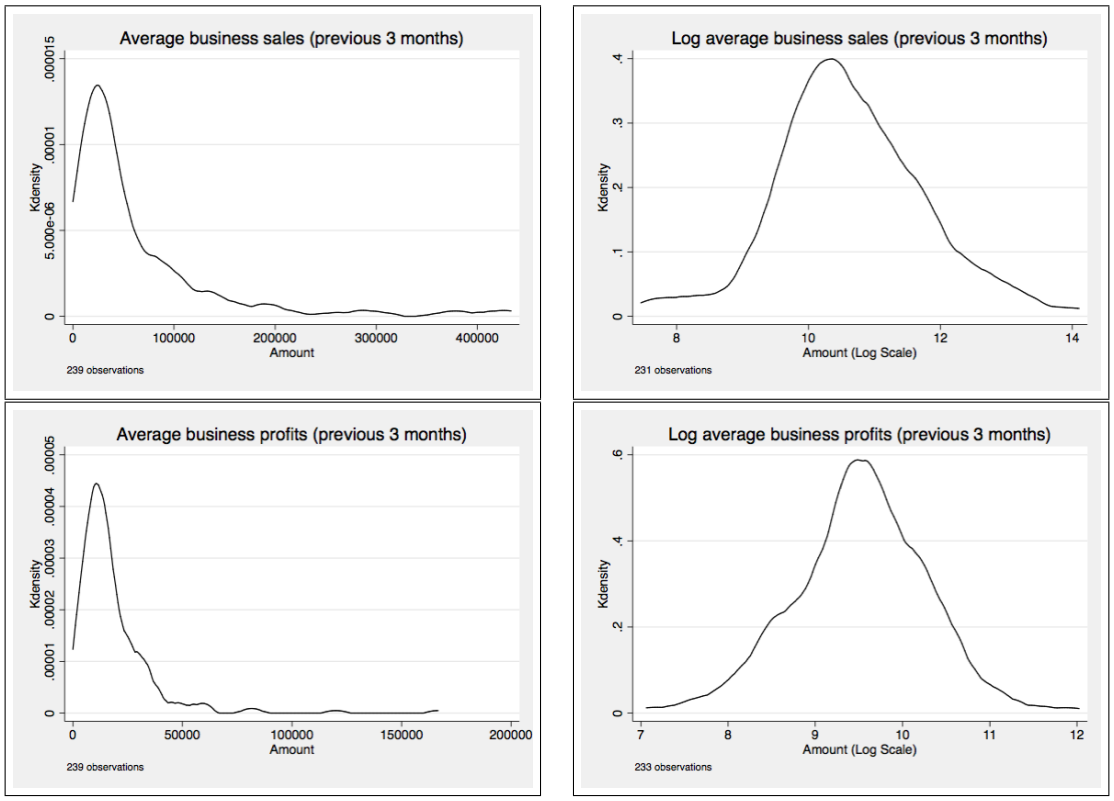
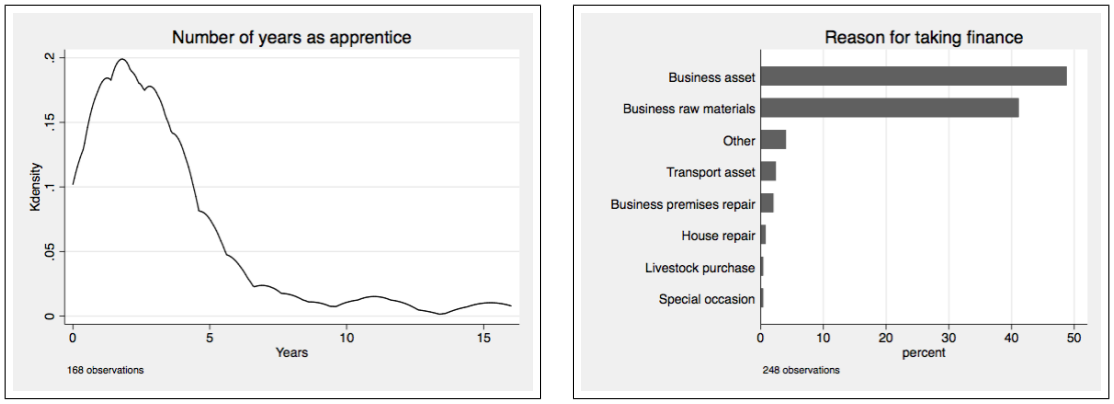


Figure 12: Background of apprentices and how the funds were used.



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