Gender, Group and Moral Hazard in Microfinance:

Evidence from Matrilineal and Patrilineal Societies in India

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Abstract

This study takes a first step to advance our understanding of the strategic interaction between the constituent components of default in microfinance and how to mitigate them. We conduct controlled microfinance field experiments in rural India to provide a systematic analysis of the relationship between gender, group liability and moral hazard. By varying the contract structure across different microfinance games, our experiment decomposes the two moral hazard (ex-ante and ex-post) channels and find that their effect on default are counteractive rather than additive for women clients. The study facilitates heterogeneity analysis of gender on moral hazard across comparable matrilineal and patrilineal societies in two neighboring states of India. We find that matrilineal women are less risk averse and are more likely to invest in the risky project (ex-ante moral hazard) than women in patrilineal societies. Moreover, we find a reversal of gender effect on strategic default (ex-post moral hazard) across the two societies, suggesting the importance of social norms and gender roles on financial behavior. Our results indicate that policymaking in microfinance should be designed by considering the heterogeneity of diverse societies, gender roles, norms and the underlying socio-economic factors that motivate financial behavior among borrowers.

JEL classification codes: D03, G02, G21, J16, O12

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1. Introduction

In their book Poor Economics, Banerjee and Dufflo (2011) mention the anecdote of daily fruit vendors in Chennai, India, who typically take a daily loan of 1000 Indian Rupees ($51PPP) from the local moneylenders in the morning and repays them 1046.90 Indian Rupees at night on average. The interest payment is an astounding 4.69% per day, implying that if a $5 loan goes unrepaid for a year, it will leave an insurmountable debt of nearly $100 million. The story delineates the point that a major constraint for the poor is the lack of access to formal credit. However, this lack of financial access is in no way unique to the fruit vendors of India. Even within the highly developed capital markets such as that of the US, nearly 26 million people, representing about 11% of all adult Americans and 30% of low-income neighborhoods are credit-invisible in that they do not have any formal credit record (Brevoort et al., 2015). The picture is gloomier if we consider the entire global economy where over 2.5 billion people, that is, almost half of world's population, use no formal financial services for either savings or borrowing (Karlan and Appel, 2011). Against this background, microfinance has emerged as an alternative way to rethink banking for the poor. The microfinance sector has witnessed a rapid expansion in the last two decades as the number of poor households with a microfinance loan has increased more than eighteen fold from 7.6 million in 1997 to 137.5 million in 2010 (Banerjee et al., 2015). In 2006 Mohammad Yunus, the pioneer of modern microfinance, and his Grameen Bank were awarded the Nobel Prize for Peace for their contribution to the reduction in world poverty through microfinance.

Microfinance can be viewed as the provision of credit and other financial services for the poor who are otherwise denied access to the same. Since these are inherently unsecured loans, default is an

important issue in microcredit. A typical microfinance loan contract includes multiple and overlapping mechanisms aimed at mitigating the risk of default. The two lending innovations that have received the maximum attention in the field are gender targeting and group liability. Under group liability contracts, individuals who are members of a borrowing group are given loans, but the entire group is liable if any group member defaults. Thus, group liability provides insurance against individual risk. While traditional banking system has historically preferred male clients, women make up the majority borrowers of most microfinance institutions' (MFIs). Indeed, many MFIs target primarily, or exclusively, women. This practice stems, *inter alia*, from the common believe that women are good credit risks. Thus targeting women clients generate high repayment rates for the lenders (Morduch, 1999; D'Espallier et al., 2011).

Why would women be better in adhering to their loan contracts than men? The reason is often attributed to the fact that women are less prone to moral hazard problems which typically leads to loan default. In microfinance, two types of moral hazard prevail, ex-ante moral hazard and ex-post moral hazard. Ex-ante moral hazard relates to the idea that unobservable actions or efforts are taken by borrowers after the loan has been disbursed but before project returns are realized. These actions affect the probability of a good realization of returns. Typically, ex-ante moral hazard refers to clients changing from a safe project to a risky project due to incentives from the loan contract (Gine et al., 2010). Ex-post moral hazard occurs when the borrower decides to default strategically once project returns are realized. Many proponents of microfinance argue that women are more risk averse and less prone to free riding behavior and are thus less subject to both moral hazard problems. A World Bank Report (2007) asserts the conventional wisdom, "Experience has shown that repayment is higher among female borrowers, mostly due to more conservative investments and lower moral hazard risk (p. 124)." Given this conventional wisdom, the next question that

follows is what drives this gender differences in behavior? The microfinance literature has not addressed this issue deeply as it broadly treats women as a homogeneous group without considering the heterogeneity created in them by socio-economic conditionings and norms of different societies which may potentially have different behavioral implications for borrowers.

The purpose of this paper is to provide a systematic analysis of the relationship between group liability, gender targeting and moral hazard. This is done by conducting controlled microfinance experiments in rural India with an individual and three group liability games and comparing them across gender. The three group liability games are ex-ante moral hazard, ex-post moral hazard and group full game. In all the three group liability games, two individuals of the same gender are randomly matched and are liable for each other's loans. In the ex-ante moral hazard control game, the subjects' only decision is to choose between a risky project and a relatively safer project. In the ex-post moral hazard control game, the subjects' only decision is whether to default strategically on their loan repayment. In the full game, the subjects make decisions over both project choice and strategic default. Thus we deconstruct the moral hazard channels by designing treatments with the two control games and comparing them to the full game. One may reasonably argue that individual risk attitudes can drive the behavior of the subjects in our experiment. Thus the experimental design implements an investment risk (IR) task to control for subject specific risk attitude. In the IR task, subjects choose what proportion of their earned endowment they want to invest in a risky lottery and thus consequently choose which lottery to play out from a set of ordered lotteries which increase linearly in both expected payoff and risk. This allows us to explicitly control for the subject's risk attitude while analyzing her behavior in the microfinance games. The paper also studies the role of social norms and gender roles on financial behavior by conducting the same microfinance experiments in two societies that have historically evolved to be different

regarding gender relation- matrilineal and traditional patriarchal (patrilineal) societies. The social norms in general and in particular, the economic rules of control of property rights are markedly different in a matrilineal society than in a patrilineal society which might have different behavioral implications. However, it is critical to the validity of the study that both the matrilineal and patrilineal societies are otherwise comparable. This is addressed by conducting the experiment with the matrilineal Khasi and patrilineal Karbi societies in two neighboring states of India. In contrast to the patrilineal Karbi society, in the Khasi society inheritance follow the female lineage through the youngest daughter in the family. It also follows a matrilocal custom in marriage whereby the husband goes to live with the wife's family where he has no property right. Thus running the same experiment in the two societies allows us to compare a pure gender effect and the interaction effect of gender and underlying social norms on behavior.

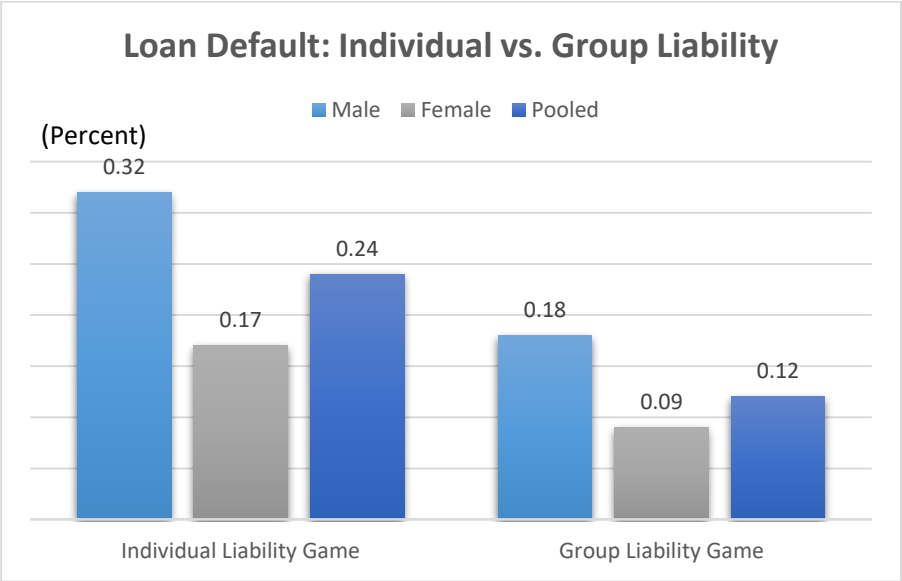
The first contribution of this work is to advance our understanding, relative to the previous literature, on the interplay between the constituent components of default in microfinance and how to mitigate them. The previous experiments in microfinance have focused exclusively on only one of the moral hazards, either ex-ante or ex-post, while abstracting from the other. The seminal experiment by Abbink et al. (2006) and Kono (2006) incorporates the possibility of only ex-post moral hazard while Cason et al. (2009) and Gine et al. (2010) focuses entirely on ex-ante moral hazard. However, one type of moral hazard may affect the other and the final default is a combination of both. In actual microfinance loan contracts, borrowers often decide both in which project to invest and whether to strategically default, and these two decisions may not be independent. This situation is incorporated in our full game treatment whereas our ex-ante control game treatment represents the settings of Abbink et al. (2006) and Kono (2006) and our ex-post control game treatment represents the baseline parameters of Cason et al. (2009) and Gine et al.

(2010). Thus, in this study, we take a first step to broadening our understanding of the strategic interaction of the constituent components of default, condoned by the prior work in microfinance experiments. Our second contribution is to systematically test the impact of gender targeting on moral hazard leading to default. Although the conventional wisdom in microfinance avers that women are les prone to moral hazards and thus are better borrowers, the previous experiments do not provide an unequivocal coclusion. Abbink et al. (2006) find lower default for females, but the authors themselves suggest that their results should be interpreted with caution (p. 15) due to the relatively small number of independent observations and the non-representative subject pool in their experiment. Kono (2006) find female borrowers are in fact more prone to ex-post moral hazard as they are more likely to choose strategic default. Gine et al. (2010) observe no gender difference in repayment due to ex-ante moral hazard. We reconcile the conventional wisdom with the previous experimental findings by analyzing the deconstructed and the full games to identify better the channels through which gender targeting operates in microfinance. The final contribution of this study is to facilitate heterogeneity analysis in gender differences across diverse societies in terms of norms and gender roles but comparable otherwise. The previous studies that have run experiments with the same matrilineal sample as ours that is, the Khasis of Meghalaya, are Gneezy et al. (2009) and Andersen et al. (2008). While the studies have found motivating results that have progressed our understanding of the sources of gender differences, they are both potentially plagued by a lack of comparable patrilineal control group. Gneezy et al. (2009) use the patriarchal Maasai society of Tanzania to compare the gender difference in competition among the Khasis. However, the two societies are in different continents and thus differ substantially regarding culture, ethnicity, and other such factors. Andersen et al. (2008) compare the provision of public good among the Khasis with two patrilineal villages in the neighboring state of Assam. However,

the author themselves provide the following caution of the confound between religion and matrilineality in their study, "An important caveat to our findings concerns the potential confound between religion and matrilineality across villages…When designing the experiments, we did not predict such a strong influence of the religion of the participants…Further research is needed to disentangle this potential confound in our data (Andersen et al., 2008; p.381)." In this regard, our study can be considered an improvement on the previous ones in that we carefully identify and conduct experiment with a more comparable patrilineal control group so as to achieve a better balance of observables between the two societies. This provides us with more confidence to draw valid inferences from our study.

Several insights emerge from our findings. A first finding is that, by and large, group liability, and gender targeting have a positive impact on reducing default. As Figure 1 shows, the average loan default rate under group liability is lower than under individual liability for the entire sample. The pattern remains unchanged when broken down by gender. Moreover, women on average display lower default rate than men.

Figure 1: Mean Loan Default Rates in Individual and Group Liability Games for Pooled Sample



A second insight emerges from decomposing the moral hazard channels and comparing them across games. We find significant evidence of both types of moral hazard induced by group liability contracts. In terms of magnitude, ex-ante moral hazard is more pronounced than ex-post moral hazard. Furthermore, we observe that the investment risk task is a significant predictor of ex-ante moral hazard, thereby calling into attention the importance of controlling for risk attitudes.

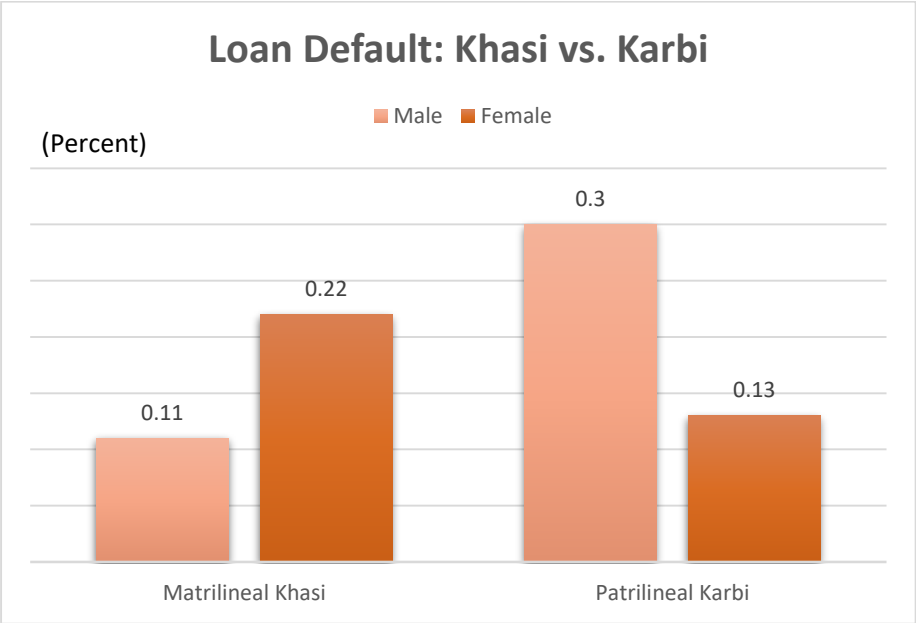
A third result indicates the importance of gender on moral hazard. We do not find any significant overall differences between the group full game and the deconstructed games. However, by interacting the games with gender, we see evidence that women exhibit both higher ex-ante and ex-post moral hazard in the deconstructed games. It suggests that the presence of both forms of moral hazard in the full game attenuate each other for women.

A final finding delineates a reversal of gender effect across matrilineal and patrilineal societies. As depicted in Figure 2, women in patrilineal Karbi society have lower default rate than Karbi men while matrilineal Khasi women have higher default rate than their male counterparts. Decomposing the moral hazard channels suggests that both Khasi and Karbi men exhibit similar

ex-ante moral hazard, but Khasi women choose risky project significantly more than Karbi women. Moreover, while Khasi men display lower ex-post moral hazard than Karbi men, Khasi women have a higher strategic default rate than Karbi women. Thus women in matrilineal society are more prone to both ex-ante and ex-post moral hazard and this effect is highly significant even after controlling for risk attitude and other demographic characteristics such as age, education, profession, household information, religion, caste, attitude towards trust etcetera. In fact, we find that Khasi women on average, default strategically more than not only Khasi men but even more than patrilineal Karbi men.

However, one can argue that the Khasi and Karbi societies share common cultural values stemming from a geographical proximity and socio-political structure as they were historically part of the same state and this might influence their behavioral patterns. Therefore, as a robustness check, the same microfinance experiments are run with Bengali men and women in the Duars region in the neighboring state of West Bengal. All of our main findings are robust when we incorporate the patrilineal Bengali sample and compare them to the matrilineal Khasis. It bolsters our conclusion that gender difference in behavior is driven by the different roles that men and women play in various societies.

Figure 2: Mean Loan Default Rates for All Games: Matrilineal Khasi vs. Patrilineal Karbi



The remainder of the study proceeds as follows. The next section provides a background on gender, group and moral hazard in microfinance. Section 3 describes the experimental design and presents an overview of the subject pool comprising of the matrilineal and patrilineal societies. In Section 4 we discuss our main empirical results while Section 5 provides various robustness tests. Section 6 discusses policy implications and concludes.

2. Background on Gender, Group and Moral Hazard

The microfinance literature often adduce group liability as a crucial innovation for the expansion of microfinance (Armendariz de Aghion and Morduch, 2005). The practice pioneered by Yunus through his Grameen Bank, has been replicated by many MFIs across the world. The rationale for the group liability contracts is risk sharing among the group members. So unless the individual risks are perfectly correlated, the overall risk of involuntary default (default due to project failure) can be substantially lower under group liability. However, in recent years, many MFIs like

Association for Social Advancement (ASA) in Bangladesh, the Bank Rakyat Indonesia (BRI), Banco Sol in Bolivia and even the Grameen Bank in its Grameen II program are moving away from group liability loans. This shift by many MFIs can be explained, at least partially, by the fact that the group liability contract structure can induce moral hazard problem for the borrowers. Since the risk of involuntary default for the entire group is lower under group liability contract, a borrower may invest in a riskier project in pursuit of higher private payoff, thereby producing ex-ante moral hazard problem. Also group liability can provoke ex-post moral hazard by providing free riding incentives to the clients. A group member may not repay the loan because she believes that another member will pay it for her. However, if all group members behave under this strategic assumption, then it leads to default for the entire group. Kono (2006) found evidence of such ex-post moral hazard by conducting field experiments in Vietnam. The study finds that group liability contracts engender serious free-riding problems, inducing strategic default and thereby lowering repayment rates. On the other hand, Abbink et al. (2006) find that group solidarity and risk-sharing among group members outweighs the ex-post moral hazard problem in their experiment. The settings of both the experiments abstract from ex-ante moral hazard incentive. On the other hand, Gine et al. (2010) incorporates only ex-ante moral hazard incentive and finds that group liability increases repayment rate from 82 to 94 percent. However, the above experiments do not tell us what happens when both types of moral hazard incentives are present. The full game treatment in our experiment aims to fill this gap whereas our ex-ante and ex-post control game treatments represent the settings of the previous experiments.

The practice of gender targeting in microfinance stems from two primary objectives. The first is based on the notion that microfinance typically enhances women's monetary income, control over their income, and their bargaining power within the household (D'Espallier et al., 2011). These

effects are expected to engender positive spillovers both within the context of the family by improving family welfare such as child schooling and healthcare, as well as in the community at large. However, this popular rhetoric in microfinance has been brought to question by recent evidence from the field. Banerjee et al. (2015) report results from the first and the longest running evaluation of microfinance from a randomized control trial in the slums of Hyderabad, India. They find no significant effect of gender targeting on health, education or women's empowerment. Even three years after providing microcredit access to women, they observe no proof of any important changes in household decision-making or social outcomes. Other recent studies such as Tarozzi et al. (2015), Attanasio et al. (2015) and Crépon et al. (2015) also show similar findings. Tarozzi et al. (2015) conduct a randomized field experiment in Ethiopia. They constructed indicators of women's empowerment and found no significant improvement of it by providing microfinance loan. Their point estimates in fact, indicate a small but not statistically significant decline in the women's empowerment indicator. They also observe that the increase in schooling attendance of children in the treated area where microfinance was provided is insignificant whereas the corresponding increase in the untreated area was substantial. Attanasio et al. (2015) also did not find any evidence of schooling impact or reduction in child labor due to microcredit program targeted towards women in their field experiment in Mongolia. Crépon et al. (2015) conducted a randomized control trial in Morocco and found no evidence on the effect of microfinance on their women empowerment index. Thus in the wake of the new evidence from the randomized control trials, this first objective of gender targeting has received some push back. However, gender targeting can still be implemented as an effective tool in microfinance for the second objective of extenuating moral hazard problem and reducing default among borrowers. Kevane and Wydick (2001) report from a field experiment that female credit groups had better loan repayment records

than male groups in Guatemala. D'Espallier et al. (2011) observe from a global data set that MFIs with more clients being women have significantly higher repayment rates. Thus it may be profit-maximizing for the lenders to target female clients, independent of other concerns about gender.

Many advocates of gender targeting in microfinance argue that women are less prone to moral hazard due to their intrinsic nature since by nature women are more risk averse and more compliant and cooperative. On the other hand, anthropologists and sociologists focus on social processes and the weight of social norms in the construction of gender relation. This suggests that the differences between men and women are not due to biological or evolutionary reasons, but rather to social conditionings. Gender socialization begins at the moment we are born, with the simple question "Is it a boy or a girl?" (Gleitman, Friedlund, and Reisberg, 2000; p. 499). In traditional patriarchal societies, it has been observed historically that women are expected to be more just, moral, disciplined and cooperative than men (D'Espallier et al., 2011). In such societies women typically do not have control over assets and property rights and have none or very little bargaining power within the family. However, these social norms are different in a matrilineal society such as the Khasi of Meghalaya, in northeast India. In the Khasi society inheritance follow the female lineage through the youngest daughter in the family. Following a matrilocal custom, Khasi men usually joins his wife's household after marriage. There he has no authority or property, is expected to work for the gain of his wife's family, and has no social roles deemed important (Gneezy et al., 2009).

We conduct same microfinance experiments in the matrilineal Khasi society and comparable patrilineal Karbi societies to get useful insights into the link between social norms and behavioral traits that influence default. Prior to our experiment, Gneezy et al. (2009) conducted a competition

game experiment with the Khasis of Meghalaya and used the patriarchal Maasai society of Tanzania in Africa to compare results. Andersen et al. (2008) conducted a public goods provision game experiment with the same Khasi population of Meghalaya and chose closer comparison groups by conducting the same experiment in two patrilineal villages in the neighboring state of Assam. However, they have a potential confound between religion and matrilineality in their study, "While the people in the Khasi village we study were mostly Christian, one of the patriarchal villages was Hindi while the other was Muslim (Andersen et al., 2008; p.377)." In order to avoid such potential confound, we identify a more comparable patrilineal control group to the Khasis to achieve a better balance of observables between the two societies. Our patrilineal sample is the Karbi in Assam who live right across the border from the Khasis. Both Khasis and Karbis are indigenous tribes and are either Christians or follow their indigenous faith (nature worship), thereby attenuating the confound between religion and matrilineality found in the previous experiments.

3. Experimental Design

3.1 Subject Characteristics

The subject pool consists of adult men and women belonging to matrilineal Khasi and patrilineal Karbi societies in two neighboring states of India. The Khasis reside in the East Khasi Hills district of Meghalaya while the Karbis live right across the border in Karbi Anglong district of Assam. Both districts were part of the state of Assam until 21 January 1972 when Meghalaya become politically separated from Assam. The two districts are only about 100 miles apart from each other and are comparable regarding their history, cultural, geography and basic economic conditions. The main difference between them is that the Khasis are a matrilineal society while the Karbis are

a traditionally patriarchal society. There are 494 subjects in total - 274 Khasi and 220 Karbi. The subjects filled out a questionnaire for which they were paid. The questionnaire collected information about their individual characteristics. Table 1 summarizes some of the most relevant individual information for each society separately.

Our average subject is 32 years old, have little over 7 years of education and has about 6 household members. Two of our most important individual level characteristics are religion and caste. Row 4-6 of Table 1 shows that 73% of each society are Christians while the rest follow their indigenous tribal religion. Also, at least 97% of both societies are schedule tribes which refers to disadvantaged indigenous people in the Indian caste system. Thus we have good balance on religion and caste across the two societies. In the questionnaire, the subjects had to write down the first names of their five close friends and were then asked how many of them do they trust enough to lend Rs. 50 (the same amount of money up to which they could invest in investment risk task). We find that the average number of close friends that the Khasis trust is 2.65 while that for Karbis is 3.08. We also find that women in both societies trust more than men on average. About 53% of the males in our sample are head of households while 18% of females are the same. This gap is smaller among the Khasis than among the Karbis. 59% of Khasis and 55% of Karbis live in temporary dwellings which are non-permanent constructions (Kutcha house) such as mud houses. 76% of the Khasis have a bank account, and 22% of them have taken out at least one loan. On the other hand, 65% of Karbis have a bank account but 34% of them have taken out at least one loan. Finally, 49% of Khasis and 68% of Karbis belong to a microfinance group; the corresponding figures are more for women than men in both the societies. These differences in observable characteristics on gender, both intra- and intersociety, highlight that it is important to control for these factors when analyzing the data.

Table 1: Summary of individual characteristics of subjects by gender and society

Individual characteristics	Overall			Khasi			Karbi		
	Pooled	Male	Female	Pooled	Male	Female	Pooled	Male	Female
Age	32.39 (11.03)	31.29 (10.46)	33.39 (11.45)	32.51 (11.74)	29.82 (9.74)	35.08 (12.88)	32.23 (10.08)	33.22 (11.05)	31.39 (9.08)
Education years	7.34 (4.26)	7.47 (4.2)	7.22 (4.32)	7.35 (4.18)	7.29 (4.19)	7.41 (4.17)	7.32 (4.36)	7.7 (4.2)	7 (4.48)
Farmer	0.36 (0.48)	0.42 (0.49)	0.31 (0.46)	0.29 (0.45)	0.31 (0.46)	0.28 (0.45)	0.45 (0.5)	0.57 (0.49)	0.34 (0.48)
Tribal religion	0.27 (0.44)	0.25 (0.43)	0.29 (0.45)	0.27 (0.45)	0.23 (0.42)	0.31 (0.46)	0.27 (0.44)	0.27 (0.45)	0.26 (0.44)
Christian	0.73 (0.44)	0.75 (0.43)	0.71 (0.45)	0.73 (0.47)	0.77 (0.42)	0.69 (0.46)	0.73 (0.44)	0.73 (0.45)	0.74 (0.44)
Schedule tribe	0.98 (0.14)	0.97 (0.18)	0.99 (0.08)	0.99 (0.12)	0.99 (0.12)	0.99 (0.12)	0.97 (0.16)	0.94 (0.24)	1 (0)
Ever married	0.71 (0.45)	0.61 (0.49)	0.81 (0.39)	0.66 (0.48)	0.52 (0.5)	0.79 (0.41)	0.78 (0.41)	0.72 (0.46)	0.84 (0.37)
Household head	0.35 (0.48)	0.53 (0.5)	0.18 (0.38)	0.34 (0.47)	0.46 (0.5)	0.22 (0.42)	0.36 (0.48)	0.63 (0.48)	0.13 (0.33)
Household members	6.22 (2.42)	6.37 (2.45)	6.09 (2.39)	6.18 (2.34)	6.37 (2.27)	6.01 (2.41)	6.28 (2.51)	6.37 (2.68)	6.19 (2.37)
Number of household durables owned	1.26 (1.17)	1.29 (1.1)	1.23 (1.24)	0.83 (0.91)	1.07 (1.02)	0.6 (0.72)	1.8 (1.24)	1.59 (1.12)	1.98 (1.32)
Lives in temporary dwellings	0.57 (0.5)	0.56 (0.49)	0.58 (0.49)	0.59 (0.49)	0.57 (0.49)	0.6 (0.49)	0.55 (0.5)	0.54 (0.5)	0.56 (0.5)
Holds a bank account	0.71 (0.45)	0.69 (0.46)	0.73 (0.44)	0.76 (0.42)	0.74 (0.44)	0.79 (0.42)	0.65 (0.48)	0.62 (0.49)	0.67 (0.47)
Microfinance group member	0.57 (0.5)	0.42 (0.49)	0.71 (0.46)	0.49 (0.5)	0.37 (0.48)	0.59 (0.49)	0.68 (0.47)	0.49 (0.5)	0.84 (0.37)
Taken at least one loan	0.27 (0.45)	0.25 (0.43)	0.29 (0.46)	0.22 (0.41)	0.17 (0.37)	0.28 (0.45)	0.34 (0.47)	0.38 (0.49)	0.31 (0.46)

Trusts number of close friends	2.84 (2)	2.64 (2.02)	3.03 (1.96)	2.65 (1.99)	2.5 (1.94)	2.79 (2.02)	3.08 (1.99)	2.82 (2.12)	3.3 (1.86)
N	494	236	258	274	134	140	220	102	118

3.2 Experimental Framework

The design framework for the microfinance loan contract consists of the individual setting and the group setting. In the individual setting, each individual is provided a loan of $L > 0$. The interest rate charged on the loan is r (such that $0 < r < 1$). Each decides to invest the loan amount L in project X or project Y. Project X leads to a return of S (such that $S > (1+r)\ L$) in the case of success with a probability of P_s and zero in the event of failure with a probability of $(1-P_s)$. Project Y leads to a return of R (s.t $R > S > (1+r)\ L$) in the case of success with a probability of P_R and zero in case of failure with a probability of $(1- P_R)$. If the project is successful, the individual has a choice to repay $(1+r)L$ or to default strategically. If the subject decides to repay, the game moves to the next round; otherwise, the game ends for that subject. Earnings from no previous rounds can be used to repay in the current round.

In the group setting, a loan of 2L is provided to a group comprising of two members. Under the group liability contract, both group members are jointly liable for the repayment of the loan. Each member of the group receives a loan of L. The interest rate charged on the loan is r (such that $0 < r < 1$). Each group member decides to invest the loan amount L in project X or project Y. Project X leads to a return of S (such that $S > (1+r)2L$) in the case of success with a probability of P_s and zero in the case of failure with a probability of $(1-P_s)$. Project Y leads to a return of R (s.t $R > S >$

(1+r)2L) in the case of success with a probability of P_R and zero in the case of failure with a probability of (1- P_R). To model joint liability in a simple and straightforward way, the debt of (1+r)2L is shared evenly among the group members who are able and willing to contribute. So if both members repay, each will pay (1+r)L, which is the same as in the individual setting. Since contributions can only be financed from the current round's project payoffs, full repayment is only possible if at least one of the group members contribute. Only if the group fulfills its repayment obligation, does the game continue into a further round, which proceeds in the same way with the same group.

3.3 Microfinance Games

We implement four microfinance games- one individual game (IG) and three group games (GG). The three group games are group ex-ante game or group game 1 (GG1), group ex-post game or group game 2 (GG2) and group full game or group game 3 (GG3). Each subject participates in only one of the games. In each round of the IG, each subject receives a loan of Indian Rupees (Rs) 20 and decides to invest it in a relatively safer project X or a riskier project Y. If project X succeeds, the investor receives a payoff of Rs 60 while if project Y succeed she receive Rs 160. If either project fails, the investor receives zero. The probability of success of project X is 5/6 while that of project Y is 1/2. Thus, following Gine et al. (2010), the expected value of the risky project is higher than the expected value of the safe project. In Stiglitz's (1990) model, safer projects are assumed

to have higher expected returns than riskier projects. However, Gine et al. (2010) observed that in their experiment participants were risk averse even over small stakes. When gross project returns were equal in expectation, risk aversion appeared to eliminate moral hazard, and most participants chose the safe project. Also the fact that risky projects have higher expected returns than safe projects induces borrowers to make risky investments in pursuit of higher incomes, and this is a more realistic assumption than the alternate one. A simple lottery, in terms of drawing colored or white balls from a bucket, is used to determine the status (success or failure) of the project. If a project is successful, the subject has a choice to repay her loan with 25% interest or to default strategically. If the subject decided to repay Rs 25, the game moves to the next round; otherwise, the game ends for the subject. Earnings from no previous rounds can be used to repay the loan in the current round. So if an individual's project fail, she cannot make the loan repayment, and the game ends. It is consistent with the dynamic incentive structure imposed by previous experiments and practiced by MFIs.

In GG, groups are formed by randomly pairing two individual subjects of the same gender. The groups remain the same throughout the experiment, but the subjects are never revealed the identities of the other group members. In GG3, a group loan of Rs 40 is provided for the repayment of which both group members are jointly liable. Each group member receives a loan of Rs 20 and decides to invest it in project X or Y which are same as in IG. Whether the project succeeds or fails is private information to the individual. If a project is successful, group members have a choice to contribute to the group repayment or default strategically. The group is liable to repay a total amount of Rs 50. To model joint liability in a simple and straightforward way, the group debt of Rs 50 is split equally among the group members who are able and willing to contribute. Thus, if both group members are willing and able to contribute then each has to contribute Rs 25 to the

group repayment which is same as in IG. However, if one member defaults, the other group member has to repay the entire group loan of Rs 50. Since contributions can only be financed from the current round's project payoffs, full repayment is only possible if at least one of the group members contribute. If the group as a whole fail to repay then, no further rounds are played, and the group members obtain no further payoffs. After each round, players are informed about their project payoff, their round payoff (comprised of one's project payoff minus the players' share of the repayment burden) and whether their partner contributed in the respective round. However, they are not provided any information about which project their partner chose, whether the project was successful and if success, whether the partner chose to strategically default. Thus, if their partner does not contribute, the subjects cannot distinguish between whether it is due to non-strategic default (project failure) or strategic default. The design of GG3 incorporates the possibility of both ex-ante and ex-post moral hazard for the subjects.

GG1 and GG2 are truncated versions of GG3. In GG1 the subjects make a decision only over project choice (project X or Y). The project probabilities and payoffs are the same as in IG and GG3. However, if a project is successful, repayment is mandatory. Thus, GG1 abstracts from ex-post moral hazard by design and only incorporates the possibility of ex-ante moral hazard. In GG2 all subjects invest in project X and make decisions only over repayment choice. Thus, GG2 abstracts from ex-ante moral hazard by design and only incorporates the possibility of ex-post moral hazard.

Each subject in all the games participated in the experiment for three rounds. They were not told about the number of rounds in advance to reduce end round effect. Also, all groups in a session completed the procedure three times, even if their play had ended as a result of the default. It

ensured that the constitution of the groups was not revealed by diverging duration of the game (this would otherwise have distorted both anonymity and the statistical independence of the groups). Moreover, it also ensures that a preference for a short playing time cannot counteract the pecuniary incentives. After the session, the subjects were paid in private for all rounds in the game.

3.4 Investment Risk Task

Since risk attitudes can potentially influence the behavior of our subjects in the microfinance game, the experiment implements a simple investment risk (IR) task. All subjects in the experiment earn endowment of Rs. 50 for filling up a questionnaire. In the IR task, the subjects can choose what portion of their earned endowment to invest in a risky lottery. The lottery returns three times the amount invested with a 50 percent chance and nothing otherwise. They keep the amount not invested in the lottery. It is equivalent to choosing which lottery to play out from a set of ordered lotteries which increases linearly in expected payoff and standard deviation. The standard deviation associated with each lottery measures the risk of that lottery. Given this parameter, a risk neutral (or risk-seeking) subject should invest the entire endowment. We show the CRRA range of the subjects based on the following CRRA specification: $U(x) = \frac{x^{1-r}}{1-r}$, when $r \neq 1$ and log (x) when $r = 1$; where r is the relative risk aversion parameter.

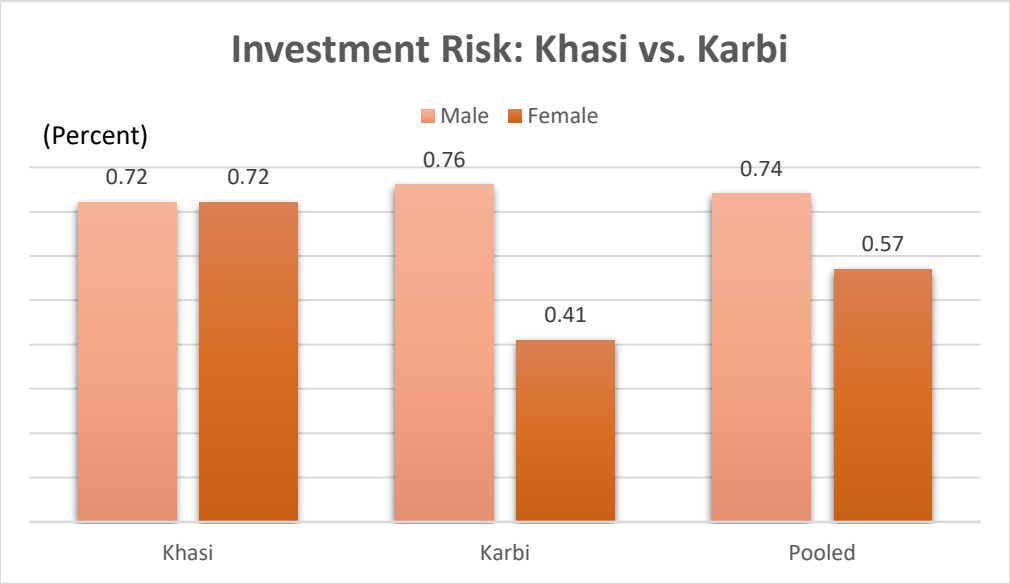
Table 2: Investment risk lotteries with CRRA range calculations

Lottery number	Proportion of earned endowmen invested	High payoff	Low payoff	Expected value	Standard deviation	CRRA Range
1	0	50	50	50	0	2.49 < r
2	0.2	70	40	55	15	0.84 < r < 2.49

3	0.4	90	30	60	30	0.5 < r < 0.84
4	0.6	110	20	65	45	0.33 < r < 0.5
5	0.8	130	10	70	60	0.18 < r < 0.33
6	1	150	0	75	75	r < 0.18

Figure 3 delineates the proportion of earned endowment invested in the risky lottery. Taking this measure as a proxy for the degree of risk aversion for the subjects, we find that there is a 17 percentage point gender gap in the pooled sample indicating that women are more risk averse than men on average. However, analyzing the two societies separately reveals that the patrilineal Karbis entirely drive this gender gap. In the Khasi society, there is no gender difference in average investment as both men and women invest 72 percent of their earned endowment in the lottery. In the Karbi sample, men invest 76 percent while women invest only 41 percent. It indicates that matrilineal women have similar risk attitude as matrlilineal men on average. On the other hand, patrilineal women are more risk averse than men on average.

Figure 3: Investment risk lottery in Khasi and Karbi sample



4 Results

4.1 Descriptive Analysis

Table 3 provides a first glimpse of the effect of different treatments on default. Column 1 shows the difference in means. Column 2 shows the p-values using simple two-sample t-tests. However, we have multiple outcomes, treatments and subgroups on which we want to conduct hypothesis testing, but the simple t-test does not account for it. Thus column 3 reports multiplicity-adjusted p-values computed using Theorem 3.1 of List et al. (2016). Column 4 and 5 report p-values from the non-parametric Mann-Whitney and Kolmogorov-Smirnov (K-S) tests to look at the difference between the underlying distributions of the samples. We find that individual liability loans have 11 percentage point higher default rate than group liability loans. We also see that men on average have a 5 percentage point higher default rate than women. Both these results are significant at $p < 0.01$ level using the unadjusted t-test as well as the multiplicity adjusted test. We obtain similar results from the Mann-Whitney test and K-S test, suggesting a statistically significant difference between the underlying distributions of the two samples.

We now deconstruct overall default into its constituent components, the ex-ante and the ex-post moral hazard. The ex-ante moral hazard is captured by the risky project choice rate while ex-post moral hazard is captured by the strategic default rate. Table 3 shows that the introduction of group liability increases the possibility of both types of moral hazard as both risky project choice, and

strategic default is significantly higher under group liability at $p < 0.01$ level. We find that subjects in the ex-ante control game have a 16 percentage point higher average risky project choice rate than in full game, which is significant at $p < 0.01$ level. On the other hand, subjects have a 3 percentage point higher average strategic default rate in the ex-post control game compared to the full game, which is significant at $p < 0.05$ in the simple means test. However, adjusting for multiple hypothesis testing, the corresponding p value increases to 0.06. We find shows significant gender difference in average risky project choice rate. Figure 4 complements this finding and provides more insight into it. It depicts that women disproportionately drive the higher risky project choice for the ex-ante game. While men only have an increase of 5 percentage point, women show an increase of 28 percentage point in choosing a risky project in the ex-ante game. Finally, the last row of Table 3 displays no significant gender difference in strategic default. However, this *prima facie* result turns out to be misinforming. Table 4 and Figure 7 confirms the existence of significant gender difference in strategic default in both Khasi and Karbi societies. However, they operate in the opposite directions and thereby counteract each other in the aggregate data.

Table 3: Parametric and non-parametric test for loan default, risky project choice and strategic default for pooled sample

		p-values			
	Difference in Means	Simple Means test	Multiplicity Adj.	Mann-Whitney	K-S test
Loan Default					
Individual vs group full	0.11	0.00***	0.00***	0.00***	0.00***
Ex-ante vs. group full	0.21	0.00***	0.00***	0.00***	0.00***
Ex-post vs. group full	-0.01	0.63	0.63	0.04**	0.06*
Male vs. female	0.05	0.00***	0.00***	0.03**	0.00***
Risky Project Choice					
Individual vs group full	-0.25	0.00***	0.00***	0.00***	0.00***
Ex-ante vs. group full	0.16	0.00***	0.00***	0.00***	0.00***

Ex-post vs. group full	---	---	---	---	---
Male vs. female	0.19	0.00***	0.00***	0.00***	0.00***
Strategic Default					
Individual vs group full	-0.08	0.00***	0.00***	0.00***	0.00***
Ex-ante vs. group full	---	---	---	---	---
Ex-post vs. group full	0.03	0.03**	0.06*	0.00***	0.00***
Male vs. female	-0.02	0.15	0.15	0.12	0.95

*** p<0.01, ** p<0.05, * p<0.1

Figure 4: Mean Risky Project Rates in Individual, Group Full and Ex-ante Control Games

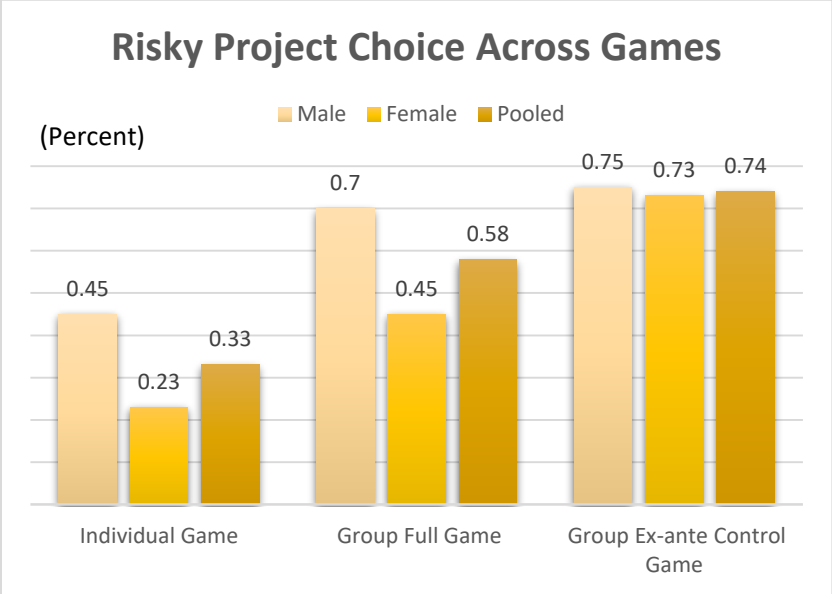
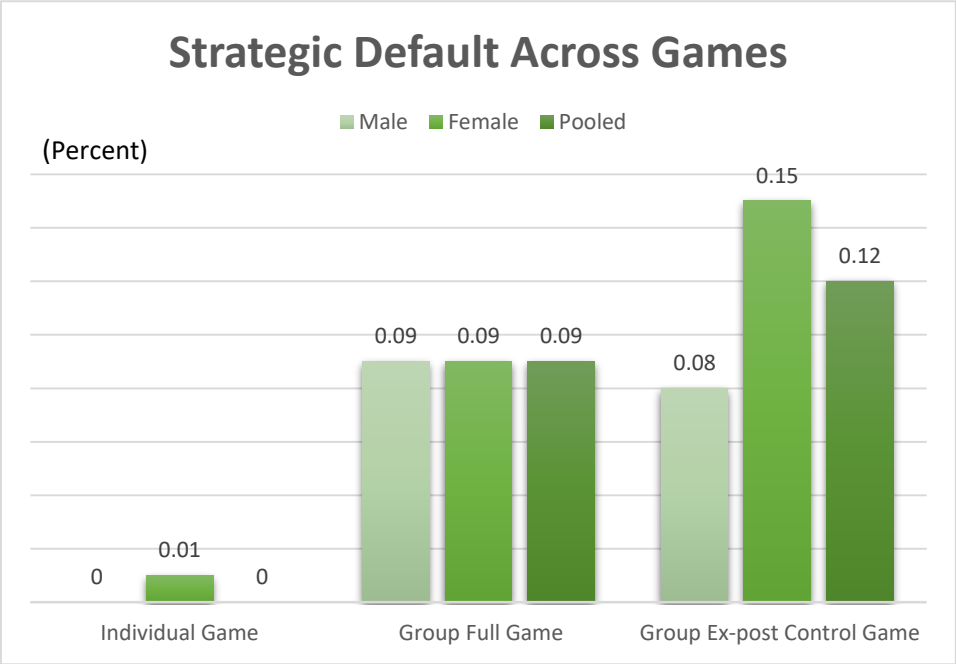


Figure 5: Mean Strategic Default Rates in Individual, Group Full and Ex-post Control Games



We now consider the diversities across matrilineal and patrilineal societies. As depicted by row 7 of Table 4, Khasi men have significantly higher risky project choice rate while Khasi women have a significantly higher strategic default rate. The non-parametric Mann-Whitney and K-S test also ratify this results. In contrast to the Khasi findings, in the Karbi society men have both higher risky project choice rate and strategic default rate which are significant at $p < 0.01$ level. Khasis have significantly higher risky project choice and strategic default rate than the Karbis. Figures 6 and 7 breaks down this last finding by gender. Figure 6 shows that the gender gap is lower among Khasis than among Karbis, although in both societies men have higher risky project choice rate. Figure 7 depicts reversal of gender difference among Khasis and Karbis for strategic default. The strategic default rate gap between men and women in both societies is about ten times, but interestingly, in the opposite direction. In Khasi society, women default more strategically while in Karbi society,

men have a higher strategic default rate. A more striking finding is that the Khasi women not only default more strategically than Khasi men but also more than Karbi men.

Table 4: Parametric and non-parametric test for loan default, risky project choice and strategic default for Khasi and Karbi sample

		p-values			
	Difference in Means	Simple Means test	Multiplicity Adj.	Mann-Whitney	K-S test
Loan Default					
Khasi male vs. female	0.11	0.00***	0.00***	0.00***	0.00***
Karbi male vs. female	0.17	0.00***	0.00***	0.00***	0.00***
Khasi vs. Karbi	-0.04	0.005***	0.03**	0.53	0.02**
Risky Project Choice					
Khasi male vs. female	0.06	0.04**	0.04**	0.02**	0.01**
Karbi male vs. female	0.32	0.00***	0.00***	0.00***	0.00***
Khasi vs. Karbi	0.15	0.00***	0.00***	0.00***	0.00***
Strategic Default					
Khasi male vs. female	-0.18	0.00***	0.00***	0.00***	0.00***
Karbi male vs. female	0.1	0.00***	0.00***	0.00***	0.00***
Khasi vs. Karbi	0.06	0.00***	0.00***	0.00***	0.00***

*** p<0.01, ** p<0.05, * p<0.1

Figure 6: Mean Risky Project Rates: Matrilineal Khasi vs. Patrilineal Karbi

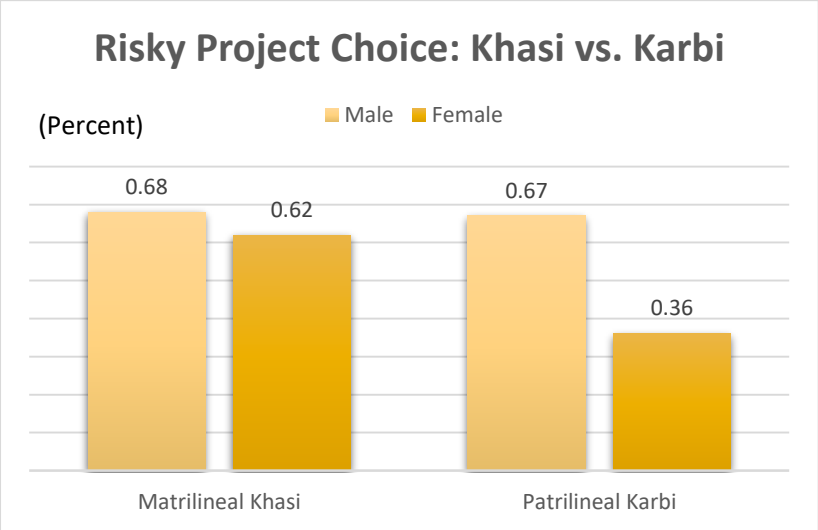
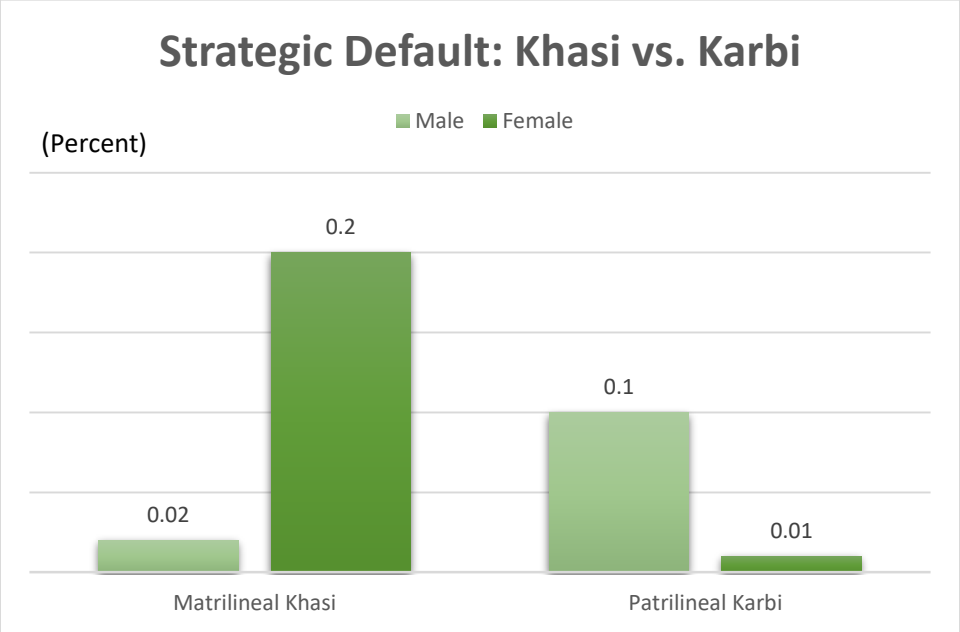


Figure 7: Mean Strategic Default Rates: Matrilineal Khasi vs. Patrilineal Karbi



4.2 Regression Results

Although the descriptive analysis provides *prima facie* evidence on the difference in behavior of subjects across games, gender and society, there has been no attempt in these unconditional tests to control for observables. To address that, we now analyze the data from our experiment in a linear regression framework by pooling from all the matrilineal and patrilineal samples. Table 5 and 6 analyze four related outcome variables. Table 5 shows the result of individual default (one if individual defaults in a round, zero otherwise) and the individual default rate which is estimated by the number of times an individual defaults divided by the number of times she receives a loan. Table 6 shows results for loan default (one if the group defaulted in a round, zero otherwise) and

the loan default rate which is estimated by the number of times a loan goes unrepaid by the number of times a loan is given. For individual games, the individual default and loan default are identical. However, for group games, these two can be different since a loan default occurs only when both the group members individually default. Column 1 of Table 5 shows a parsimonious specification where we regress the outcomes only on a dummy variable for gender (one if the subject is female, zero otherwise) and a dummy variable for group liability loans (one if behavior is observed in the treatment with group liability, zero for individual liability). We include round fixed effects and cluster the standard errors at the individual level. In the second specification (S2), we add subjects' decision in the investment risk (IR) task to control for their risk attitude. In addition we add a multitude of observable characteristics that have been shown to be important by previous studies such as age, years of education, profession, religion, caste, attitude towards trust, household information, whether the subject is head of the family, holds a bank account, belongs to a microfinance group and has taken a loan. The results suggest that group liability increases individual default by 10 percent point, and it is significant at $p < 0.05$ level. In the first column of Table 5, we see that women are 7 percent more likely to default individually, and it is significant at $p < 0.05$. However, conditioning on observables, the coefficient magnitude reduces, and it no longer remains significant.

Table 6 looks at loan default by clustering the standard errors at the group level. Individual liability loans are considered group with size n=1. In contrast to Table 5, here we find that group liability reduces the probability of loan default in a round by 9 percent and the loan default rate by 12 percentage point. These are both significant at $p < 0.01$ level. So we find that although group liability increases individual default, overall default on a loan is lower under it. It can be attributed to the risk sharing among group members that reduce the likelihood of involuntary or non-strategic

default in group liability loans. Thus from a lender's perspective, group liability contracts are more profitable. The coefficient estimates on female suggest that women have a ten percentage point lower loan default rate than men. These two findings together rationalize the targeting of women groups by the MFIs. This leads to our first formal result:

RESULT 1: *Group liability and gender targeting improve the microfinance lender's bottom line.*

Table 5: Linear regression results for individual default for pooled sample

Outcome variables:	Individual default		Individual default rate	
	S1	S2	S1	S2
Group liability	0.11***	0.12***	0.08**	0.1**
	(0.03)	(0.03)	(0.03)	(0.04)
Female	-0.07**	-0.002	-0.1***	-0.01
	(0.03)	(0.03)	(0.03)	(0.04)
Investment risk	—	0.04	—	0.04
		(0.04)		(0.05)
Round fixed effects	Yes	Yes	—	—
Demographic controls	No	Yes	No	Yes
Total observations	1,102	1,102	1,194	1,194
Independent observations	398	398	398	398
R-squared	0.03	0.06	0.04	0.13

Robust standard errors, clustered at individual level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Linear regression results of loan default for pooled sample

Outcome variables:	Loan default	Loan default rate
Group liability	-0.09***	-0.12***
	(0.02)	(0.04)
Female	-0.06***	-0.1***
	(0.02)	(0.03)
Round fixed effects	Yes	—
Total observations	1,103	1,194
Independent observations	257	257
R-squared	0.05	0.06

Robust standard errors, clustered at group level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

We now decompose the channels through which default can occur by considering ex-ante and ex-post moral hazard. The ex-ante moral hazard channel is observed through the risky project choice while the ex-post channel can be seen through strategic default. Table 7 shows that group liability increases the selection of the risky project by 25 percentage point and strategic default rate by 7 percentage point, both of which are significant at $p < 0.01$. These findings delineate that group liability induces both types of moral hazard problem among the borrowers. Also, it shows that the magnitude of the coefficients for ex-ante moral hazard is more than an ex-post moral hazard. We find that women choose risky project significantly less than men, although the extent of gender gap reduces when we control for observable characteristics. However, we do not find any significant gender difference in strategic default. It indicates that gender disparities in default in the pooled sample as observed in Table 5 and 6 is mainly driven by the gender gap in ex-ante moral hazard and not in the ex-post moral hazard. We also find that the investment risk task is a significant predictor of the risky project choice of the subjects in our experiment. The coefficient

estimates show that an increase in investment of 20 percent of the earned endowment in a lottery by a subject is associated with a 40 percent higher likelihood of her choosing the risky project. This finding highlights the importance of controlling for risk attitude in our empirical model. We can now state our second result.

RESULT 2: *Group liability induces both ex-ante and ex-post moral hazard among borrowers.*

Table 7: Linear regression results of risky project and strategic default for pooled sample

Outcome variables:	Risky project choice		Risky project choice rate		Strategic default		Strategic default rate	
	S1	S2	S1	S2	S1	S2	S1	S2
Group liability	0.25***	0.25***	0.24***	0.24***	0.08***	0.07***	0.08***	0.07***
	(0.04)	(0.05)	(0.04)	(0.05)	(0.02)	(0.02)	(0.02)	(0.02)
Female	-0.23***	-0.11**	-0.25***	-0.12**	0.001	0.03	0.001	0.03
	(0.03)	(0.05)	(0.04)	(0.05)	(0.02)	(0.04)	(0.02)	(0.04)
Investment risk	__	0.4***	__	0.4***	__	0.02	__	0.02
		(0.06)		(0.06)		(0.03)		(0.03)
Round fixed effects	Yes	Yes	__	__	Yes	Yes	__	__
Demographic controls	No	Yes	No	Yes	No	Yes	No	Yes
Total observations	1,105	1,105	1,194	1,194	866	866	1,116	1,116
Independent observations	398	398	398	398	372	372	372	372
R-squared	0.11	0.21	0.19	0.35	0.02	0.07	0.03	0.11

Robust standard errors, clustered at individual level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Next we analyze the strategic interaction between the two types of moral hazard by comparing the full game and the two control games. Row 1 and 2 of Table 8 shows that there is no significant overall difference in moral hazard between the control and the full games. However, interacting the games with gender provide interesting insights into the underpinnings of the

moral hazard channels. We find that women in ex-ante control game have a 20 percentage point higher risky project choice rate than in the full game even after controlling for risk attitude and individual characteristics. This result is significant at $p < 0.01$ level. Women in the ex-post control game are 6 percent more likely to default strategically than in the full game although this effect is not statistically significant. Combining these two findings indicate that women are more prone to moral hazard in the control games than in the full game. It corroborates the findings from Figure 4 and 5 and provides our second major result.

RESULT 3: *Contract structures with possibilities of ex-post moral hazard significantly reduce ex-ante moral hazard for women.*

Table 8: Linear regression results of risky project and strategic default for group games

Outcome variables:	Risky project choice		Risky project choice rate		Strategic default		Strategic default rate	
	S1	S2	S1	S2	S1	S2	S1	S2
Ex-ante control game	0.06	0.07	0.05	0.05	—	—	—	—
	(0.05)	(0.04)	(0.05)	(0.04)				
Ex-post control game	—	—	—	—	-0.01	-0.03	-0.01	-0.03
					(0.02)	(0.03)	(0.03)	(0.03)
Female	-0.24***	-0.09*	-0.26***	-0.11**	-0.002	0.03	-0.002	0.03
	(0.04)	(0.05)	(0.05)	(0.05)	(0.02)	(0.03)	(0.03)	(0.04)
Ex-ante*Female	0.22***	0.17**	0.24***	0.2***	—	—	—	—
	(0.07)	(0.07)	(0.07)	(0.07)				
Ex-post*Female	—	—	—	—	0.08	0.06	0.08	0.06
					(0.05)	(0.05)	(0.05)	(0.05)
Investment risk	—	0.47***	—	0.45***	—	0.07*	—	0.04
		(0.05)		(0.06)		(0.03)		(0.04)
Round fixed effects	Yes	Yes	—	—	Yes	Yes	—	—
Demographic controls	No	Yes	No	Yes	No	Yes	No	Yes
Total observations	1,138	1,138	1,248	1,248	962	957	1,200	1,194
Independent observations	416	416	416	416	398	398	398	398
R-squared	0.04	0.06	0.07	0.13	0.04	0.1	0.01	0.1

Robust standard errors, clustered at individual level, in parentheses, *** p<0.01, ** p<0.05, * p<0.1

4.3 Matrilineal vs. Patrilineal

Our experimental sample incorporates ample variation across societies which provide the opportunity to evaluate heterogeneity in gender effects by comparing different societies regarding gender relations. We analyze the Khasi and Karbi sample in a linear regression framework by pooling data from all the games. We find that the Khasis overall have a 23 percentage point lower loan default rate, which is significant at $p < 0.01$ level. However, row 3 of Table 9 shows that Khasi women have a 29 percentage point higher default rate than Karbi women which is also significant at $p < 0.01$ level. These two results together imply that the Khasi men have substantially lower default rate than Karbi men. It is depicted in Figure 2 and represents the basis of our next result.

RESULT 4: *Loan default is lower in matrilineal society and is entirely due to the matrilineal men.*

Table 9: Linear regression results for loan default for Khasi and Karbi sample

Outcome variables:	Loan default	Loan default rate
Female	-0.14***	-0.21***
	(0.05)	(0.07)
Khasi	-0.14***	-0.23***
	(0.04)	(0.08)
Female*Khasi	0.2***	0.29***
	(0.05)	(0.08)
Group liability	-0.11***	-0.14***
	(0.03)	(0.07)
Round fixed effects	Yes	—
Total observations	825	1,194
Independent observations	189	189
R-squared	0.07	0.15

Robust standard errors, clustered at group level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

We now decompose the channels which constitute gender difference in default by considering the choice of risky project and strategic default. The second row of Table 10 shows that there is no

significant difference between the two societies for risky project choice. However, the Khasis have a 10 percentage point lower strategic default rate which is significant at $p < 0.01$ level. It implies that the lower loan default of Khasis as observed from Table 7 can be attributed to the difference in ex-post moral hazard between the two societies. It provides the following result.

RESULT 5: *The lower loan default in matrilineal society is attributed to lower ex-post moral hazard.*

Row 3 of Table 10 suggests that Khasi women have both higher risky project choice and strategic default than Karbi women. The coefficient estimates show that after controlling for risk attitude and other observable characteristics, Khasi women have a 13 percentage point higher risky project choice rate, which is significant at $p < 0.1$ level. This leads to our next result.

RESULT 6: *Women in matrilineal society are more likely to invest in the risky project than women in patrilineal society.*

One of our most notable findings in terms of significance and magnitude is on strategic default. The coefficient estimates from Table 10 show that Khasi women have a 26 percentage point higher strategic default rate than Karbi women, which is significant at $p < 0.01$ level. Again, from row 2 we see that overall Khasis have a significantly lower strategic default rate of 10 percentage point. Examining these two results together, we can logically conclude that Khasi men have a lower strategic default rate than Karbi men. It corroborates the findings from Table 3 and Figure 7 of our descriptive analysis. In fact, Figure 7 depicts that Khasi women default strategically more than not only Karbi women but even more than Karbi men. On the other hand, Khasi men strategically default less not only than Karbi men but almost only as much as Karbi women. Thus in this

context, we observe that matrilineal women behave like patrilineal men while matrilineal men behave more like patrilineal women. We formalize our next result from the above finding.

RESULT 7: *Women in matrilineal society default strategically more than women in patrilineal society, while the pattern reverses for men.*

Table 10: Linear regression results for risky project choice and strategic default for Khasi and Karbi sample

Outcome variables:	Risky project choice		Risky project choice rate		Strategic default		Strategic default rate	
	S1	S2	S1	S2	S1	S2	S1	S2
Female	-0.32***	-0.17***	-0.31***	-0.16**	-0.09***	-0.08**	-0.09***	-0.08**
	(0.06)	(0.06)	(0.06)	(0.07)	(0.03)	(0.04)	(0.03)	(0.04)
Khasi	0.03	0.04	0.01	0.005	-0.08***	-0.08***	-0.08***	-0.08***
	(0.06)	(0.05)	(0.06)	(0.06)	(0.03)	(0.03)	(0.03)	(0.03)
Female*Khasi	0.26***	0.12*	0.26***	0.12	0.27***	0.26***	0.27***	0.26***
	(0.07)	(0.07)	(0.07)	(0.07)	(0.04)	(0.05)	(0.04)	(0.05)
Group liability	__	0.28***	__	0.28***	__	0.1***	__	0.1***
		(0.05)		(0.05)		(0.02)		(0.02)
Investment risk	__	0.36***	__	0.37***	__	0.02	__	-0.01
		(0.06)		(0.06)		(0.03)		(0.03)
Round fixed effects	Yes	Yes	__	__	Yes	Yes	__	__
Demographic controls	No	Yes	No	Yes	No	Yes	No	Yes
Total observations	1,067	1,067	1,188	1,188	923	918	1,128	1,122
Independent observations	396	396	396	396	376	374	376	374
R-squared	0.04	0.2	0.1	0.14	0.06	0.38	0.13	0.22

Robust standard errors, clustered at individual level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 11 analyzes the proportion of earned endowment invested in a risky lottery, which is taken as a proxy for risk attitude. We find that women on average invest about 30 percent less of their earned endowment in a risky lottery, which is significant at $p < 0.01$ level. We do not find any difference in average risk attitude between the Khasi and the Karbi society. Since the investment

risk task takes place after the three microfinance rounds in all our experimental sessions, the earnings from the microfinance game rounds may influence the amount invested in the lottery. Thus we control for the microfinance round earnings in our regression model. We find that although statistically significant, the coefficient estimate of the microfinance round earnings is 0.0004 which can be considered negligible and therefore may not be economically significant. Our most important finding from Table 11 is that after controlling for microfinance round earnings and other observable characteristics, Khasi women invest 39 percent more of their investment into the lottery than Karbi women. It corroborates the finding from Figure 4 and leads to our next result.

RESULT 8: *Women in matrilineal society are less risk averse than women in other societies.*

Table 11: Linear regression results for investment risk for Khasi and Karbi sample

Outcome variables:	Investment risk (S1)	Investment risk (S2)
Female	-0.35***	-0.33***
	(0.04)	(0.05)
Khasi	-0.04	-0.03
	(0.04)	(0.05)
Female*Khasi	0.35***	0.39***
	(0.06)	(0.06)
Microfinance round earnings	—	0.0004***
		(0.0001)
Round fixed effects	Yes	Yes
Demographic controls	No	Yes
Total observations	1,482	1,476
Independent observations	494	492
R-squared	0.17	0.24

Robust standard errors, clustered at individual level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

5 Robustness Tests

5.1 Patrilineal Sample Selection

The first set of robustness tests is in terms of our sample selection. Although in our empirical model we have controlled for a host of observable characteristics to compare across the matrilineal and patrilineal societies, one might argue that the proximity and shared culture and history of the Khasi and Karbi societies might influence the behavior of the subjects in a way that is not explicitly captured in our model. Thus, as a robustness test, we run the same treatments with Bengali men and women in the Dooars region in the neighboring state of West Bengal, about 300 miles away from the East Khasi Hills. Unlike the Karbis, the Khasis of Meghalaya and the Bengalis of West Bengal were never part of the same state. Moreover, the Bengalis are not an indigenous tribe like the Khasis and Karbis. The Bengali society is a mainstream society and the gender relation among them is representative of that of India as well as most of the developing world.

Table 12 shows that that the Khasis overall have a 20 percentage point lower loan default rate, which is significant at $p < 0.01$ level. Row 3 of Table 12 shows that Khasi women have a 29 percentage point higher default rate than Karbi women which is also significant at $p < 0.01$ level. These two results together imply that the Khasi men have lower default rate than Bengali men. These results are very similar to the ones obtained from Table 7 where we compare the Khasi and the Karbis. Figure 8 delineates the reversal of gender difference which is again similar to the one depicted in Figure 2. A notable observation from Figure 8 is that the average loan default rate for Khasi men is the same as that of Bengali women.

Table 12: Linear regression results for loan default for Khasi and Bengali sample

Outcome variables:	Loan default in a round	Loan default rate
Female	-0.16***	-0.21***
	(0.05)	(0.07)
Khasi	-0.16***	-0.2***
	(0.05)	(0.07)
Female*Khasi	0.22***	0.29***
	(0.06)	(0.08)
Group liability	-0.09***	-0.1**
	(0.03)	(0.05)
Round fixed effects	Yes	—
Total observations	706	750
Independent observations	161	161
R-squared	0.09	0.14

Robust standard errors, clustered at group level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Figure 8: Mean Loan Default Rates: Matrilineal Khasi vs. Patrilineal Bengali

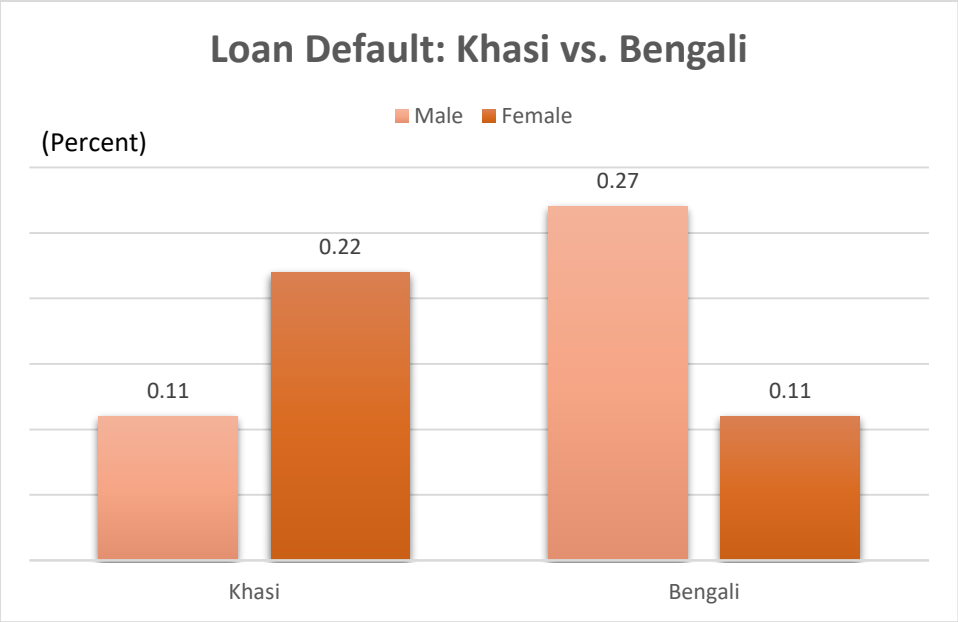


Table 13 decomposes the channels which constitute gender difference in default. The coefficient estimates from row 2 suggest that Khasis have lower strategic default rate than Bengalis, although it is not significant once we control for observables. Figure 9 delineates that the gender gap in risky project choice is much less among the Khasis than among the Bengalis. It also shows that the men in the two societies have similar risky project choice, but the Khasi women are more likely to choose risky project than Bengali women. This is supported by the regression model (row 3 of Table 13), although the coefficient estimates are not significant once we control for observables. On the other hand, even after controlling for risk attitude and other observable characteristics, Khasi women have a 28 percentage point higher strategic default rate than Bengali women, which is significant at $p < 0.01$ level. This can also be seen from the visual depiction of Figure 10 which shows that Khasi women default strategically more than not only Bengali women but even more than Bengali men. On the other hand, Khasi men strategically default less than Bengali men and the same as Bengali women.

Thus we find that, on the whole, all of our major results from comparing the Khasi and Karbi sample remains unchanged as we compare the Khasis to the Bengalis. We find that Khasis overall have lower loan default than Bengalis whereas Khasi women are significantly more likely to default than Bengali women. We also observe that the Khasi women default strategically not only more than Khasi men but even more than Bengali men. Figure 8 and 10 delineate this same pattern of the reversal of gender effect on default as we have observed between the Khasis and Karbis. Thus, we can reason with confidence that our findings are not an artifact of the particular patrilineal Karbi society selected to compare with the Khasis. This fortifies our outcomes across the societies and leads to the following result.

RESULT 9: *The gender effects across the matrilineal and patrilineal societies are robust to the selection of the patrilineal sample in our experiment.*

Table 13: Linear regression results for risky project choice and strategic default for Khasi and Bengali sample

Outcome variables:	Risky project choice		Risky project choice rate		Strategic default		Strategic default rate	
	S1	S2	S1	S2	S1	S2	S1	S2
Female	-0.18***	-0.13*	-0.21***	-0.16**	-0.09***	-0.1**	-0.1***	-0.12**
	(0.06)	(0.07)	(0.06)	(0.07)	(0.02)	(0.05)	(0.03)	(0.06)
Khasi	0.06	0.08	0.04	0.05	-0.09***	-0.04	-0.1***	-0.05
	(0.06)	(0.09)	(0.05)	(0.09)	(0.03)	(0.04)	(0.03)	(0.04)
Female*Khasi	0.12	0.05	0.16**	0.07	0.25***	0.24***	0.28***	0.28***
	(0.08)	(0.07)	(0.08)	(0.07)	(0.04)	(0.05)	(0.05)	(0.05)
Group liability		0.32***		0.33***		0.08***		0.1***
		(0.06)		(0.06)		(0.02)		(0.03)
Investment risk		0.4***		0.39***		0.03		0.01
		(0.06)		(0.06)		(0.03)		(0.04)
Round fixed effects	Yes	Yes	Yes	Yes	—	—	—	—
Demographic controls	No	Yes	No	Yes	No	Yes	No	Yes
Total observations	960	960	1,044	1,044	816	814	1,011	1,008
Independent observations	348	348	348	348	337	336	337	336
R-squared	0.09	0.21	0.1	0.14	0.12	0.34	0.13	0.21

Robust standard errors, clustered at individual level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Figure 9: Mean Risky Project Choice Rates: Matrilineal Khasi vs. Patrilineal Bengali

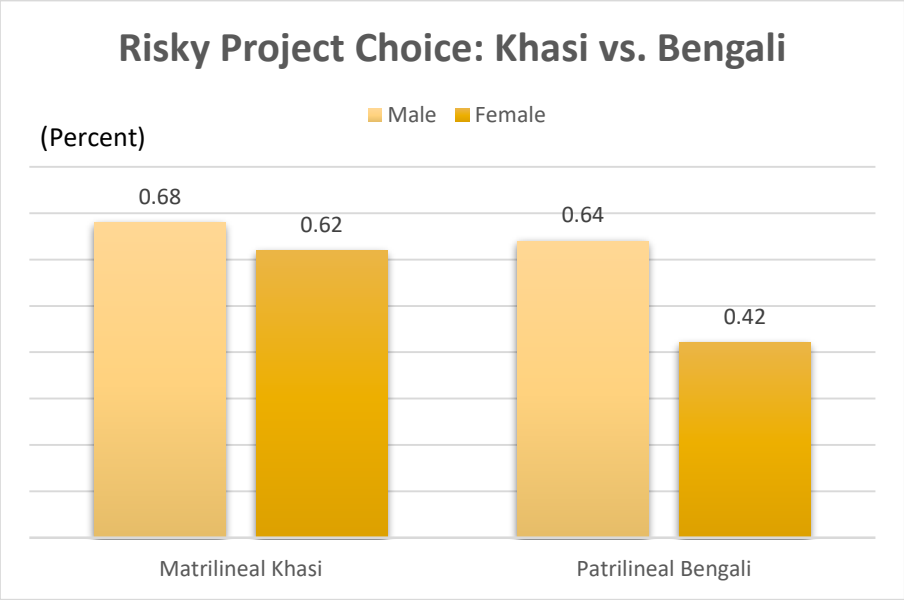
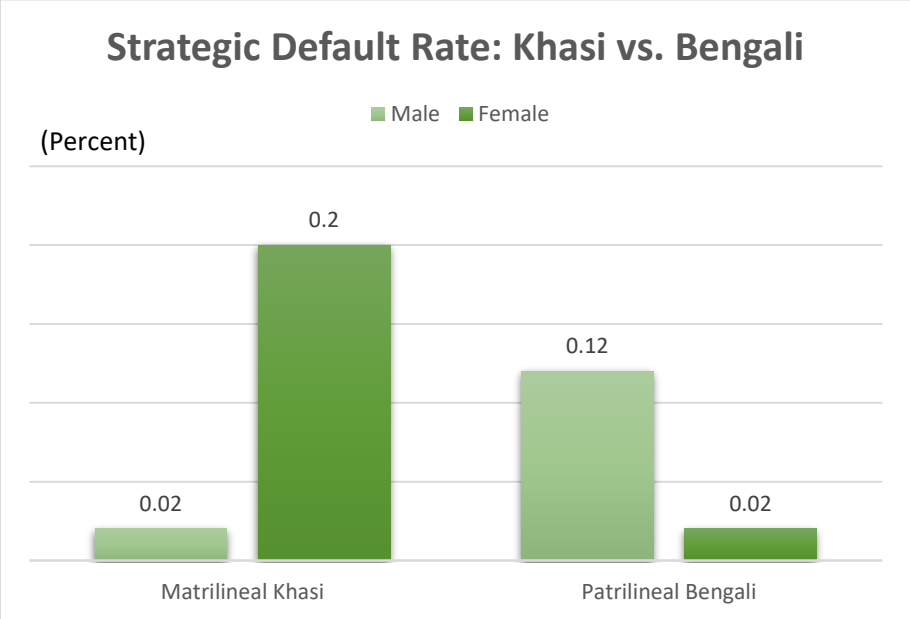


Figure 10: Mean Strategic Default Rates: Matrilineal Khasi vs. Patrilineal Bengali



5.2 Nonlinear Model Specifications

The next set of robustness tests is regarding our empirical model specifications. All our dependent variables are either binary or in rates and are bounded between 0 and 1. Both of these are suitable for nonlinear estimations. Hence for the dependent variables loan default (1if loan goes unrepaid, 0 otherwise), risky project choice (1 if the risky project is chosen, 0 otherwise) and strategic default (1 if subjects default strategically, 0 otherwise), we use a Probit regression model. For the corresponding rates, we implement a fractional response model for our empirical analysis. A Beta model would have provided more flexibility in the distribution of the mean of the dependent variables. However, it will be misspecified in our case as our dependent variables are not strictly bounded between 0 and 1. Our fractional response models fit Probit regression via maximum likelihood to obtain parameter estimates. An advantage of this estimation method is that we do not need to know the true distribution of the entire model to get consistent parameter estimates. As long as the conditional mean of the model is the same as the conditional mean of a Probit model, we will be able to obtain consistent point estimates even if the true model is not a probit. Table 14 provides marginal coefficients from Probit and Fractional Response Models. Our results are akin regarding sign, significance, and even magnitude as we compare the marginal coefficients to results from Table 6. The marginal coefficient for group liability is only 1 percentage point lower whereas the coefficient for females is the same as in the linear regression model.

Table 14: Probit and Fractional Response results of loan default for pooled sample

Outcome variables:	Loan default	Loan default rate
Group liability	-0.08***	-0.11***
	(0.02)	(0.03)
Female	-0.06***	-0.1***
	(0.02)	(0.04)
Round fixed effects	Yes	—
Observations	1,103	1,194
R-squared	0.07	0.04

Robust standard errors, clustered at group level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Results from Table 15 can be compared to that of table 9 to analyze the strategic interaction between ex-ante and ex-post moral hazard. Similar to the results from our linear specification, we find that women in ex-ante control game have significantly higher risky project choice rate and are more likely to strategically default in the ex-post control game compared to the full game. Even after controlling for risk attitude and individual observable characteristics, women are 16 percent more likely to choose a risky project and default strategically in the control games. Both of these findings are significant at $p < 0.05$ level. This corroborates RESULT 2 obtained from our linear regression model.

Table 15: Probit and Fractional Response results of risky project and strategic default for group full and control games

Outcome variables:	Risky project choice		Risky project choice rate		Strategic default		Strategic default rate	
	S1	S2	S1	S2	S1	S2	S1	S2
Ex-ante control game	0.06	0.07	0.05	0.05	—	—	—	—
	(0.05)	(0.04)	(0.06)	(0.05)				
Ex-post control game	—	—	—	—	0.02	-0.01	-0.01	-0.02
					(0.06)	(0.06)	(0.04)	(0.04)
Female	-0.23***	-0.07	-0.24***	-0.09**	-0.03	0.01	-0.003	0.01
	(0.04)	(0.05)	(0.04)	(0.05)	(0.05)	(0.06)	(0.03)	(0.03)
Ex-ante*Female	0.2***	0.16**	0.22***	0.19**	—	—	—	—
	(0.07)	(0.06)	(0.07)	(0.07)				
Ex-post*Female	—	—	—	—	0.16**	0.16**	0.07	0.05
					(0.08)	(0.08)	(0.05)	(0.05)
Investment risk	—	0.44***	—	0.43***	—	0.09	—	0.04
		(0.04)		(0.04)		(0.06)		(0.04)
Round fixed effects	Yes	Yes	—	—	Yes	Yes	—	—
Demographic controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1,132	1,132	1,248	1,248	962	914	1,200	1,194
R-squared	0.05	0.16	0.05	0.16	0.06	0.15	0.01	0.11

Robust standard errors, clustered at individual level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 16 compares the results from the linear regression model of Table 11. The marginal coefficients from the Probit and the Fractional Response model delineate similar findings that Khasi women are more likely to choose risky project than Karbi women. Khasi women have a 50 percent higher probability of strategic default which is significant at $p < 0.01$ level. These findings confirm RESULT 5 and 6 from our linear regression model. Thus we observe that in terms of sign, significance, and even magnitude, the coefficients obtained from the Probit, and the fractional

response model is very similar to the linear regression model. It indicates that our findings are robust to the empirical model specification.

Table 16: Probit and Fractional Response results for risky project choice and strategic default for Khasi and Karbi sample

Outcome variables:	Risky project choice		Risky project choice rate		Strategic default		Strategic default rate	
	S1	S2	S1	S2	S1	S2	S1	S2
Female	-0.31***	-0.15**	-0.3***	-0.14**	-0.26***	-0.24***	-0.13**	-0.13**
	(0.06)	(0.06)	(0.05)	(0.06)	(0.08)	(0.08)	(0.05)	(0.05)
Khasi	0.03	0.05	0.01	0.03	-0.14***	-0.13***	-0.11***	-0.11***
	(0.06)	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)	(0.03)	(0.03)
Female*Khasi	0.25***	0.1	0.24***	0.1	0.51***	0.48***	0.3***	0.28***
	(0.07)	(0.07)	(0.07)	(0.07)	(0.09)	(0.08)	(0.06)	(0.06)
Group liability		0.27***		0.27***		0.25***		0.16***
		(0.05)		(0.05)		(0.07)		(0.05)
Investment risk		0.34***		0.35***		0.001		-0.01
		(0.05)		(0.05)		(0.05)		(0.03)
Round fixed effects	Yes	Yes	—	—	Yes	Yes	—	—
Demographic controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1,067	1,062	1,188	1,188	923	881	1,128	1,122
R-squared	0.06	0.17	0.05	0.16	0.2	0.29	0.15	0.27

Robust standard errors, clustered at individual level, in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

6 Conclusion

This study takes a first step to expand our understanding of the interplay between the underlying factors of default in microfinance. In doing so, it uncovers important mechanisms of the relationship between gender and default. By implementing different contract structures, our experiment decomposes ex-ante and ex-post moral hazard channels through which gender targeting can influence default. We observe that when women are faced with loan contracts that incorporate the possibilities of both ex-ante and ex-post moral hazard, the two counteract each other. Thus we find that the nature of relationship between the two moral hazard channels is interactive rather than additive for women. The study facilitates heterogeneity analysis in gender differences across comparable matrilineal and patrilineal societies. We find that average default is lower in matrilineal society and is due to matrilineal men rather than women. Matrilineal women are less risk averse, more likely to invest in the risky project and default strategically than women in patrilineal societies. Particularly, we find that matrilineal women default strategically on their loan not only more than patrilineal women but even more than patrilineal men. Our results are robust to the particular choice of the patrilineal society and suggest that the social norms and gender roles influence behavior among microfinance borrowers.

Thus our findings might have import for policy making in microfinance. Our broad findings support the extant policy of group liability contracts and gender targeting adopted by many MFIs around the world. However, group liability can also engender ex-ante and ex-post moral hazard among borrowers to some extent. Our results imply that policy should not be targeted to mitigate either ex-ante or ex-post moral hazard in isolation as it may escalate the other form of moral hazard, especially for women clients. Microfinance contracts should be designed such that the two forms

of moral hazard counteract each other. Finally, our results reveal gender targeting has a heterogeneous effect across societies. Thus policymaking in microfinance should be designed keeping in mind the heterogeneity of diverse societies, the distinct roles that men and women play in them and the underlying socio-economic factors that motivate financial behavior. However, our findings should be interpreted with the caveat that we have sampled only a limited number of villages in a particular matrilineal region in India. We do not allege that our results will be a universal truth amongst all matrilineal societies everywhere. Rather we view our results as providing some initial insights into the underpinnings of the factors hypothesized to be important determinants of gender differences in microfinance. We trust that future studies will more thoroughly explore the sources of gender differences in behavior in this area of research.

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