Efficiency of Islamic Finance Contracts: Microfinance Experiments

Mohamed El-Komi[1]
Rachel Croson[2]

1. INTRODUCTION

This paper describes and experimentally tests Islamic-compliant microfinance products. While both microfinance and Islamic (macro)finance are well-developed fields of study, very little previous research has examined their intersection. This endeavor is important for economic development. Microfinance has been demonstrated to be an invaluable tool in increasing the productivity of the poor and in aiding economic development (Comim 2007, Dowla and Barua 2006, Wright 2000, Islam 2007), however, because microfinance typically involves the payment of interest, participation in these programs is limited.

It is estimated that over 1/3 of the world's poor are Muslims (CIA World Factbook 2010 and Economist 2008), and thus many unable to take advantage of existing, interest-based, microfinance products (Karim *et al*. 2008). The Consultative Group to Assist the Poor (CGAP) conducted a global survey in 19 Muslim countries in 2007, in which 20-40% of the respondents cited religious reasons for not using conventional microloans. Constructing and making available Islamic-compliant microfinance products would extend the reach of microfinance and aid in the economic progress of the Muslim poor and of nations with large Islamic populations.

Karlan and Morduch (2009) stress the importance of the way microfinance choices are offered, and argue that they may matter more than the pure economics of the choices with regards to take-up rates. The products tested in this paper contribute to the variety of microfinance choices, which should result in higher take-up rates of microfinance products. At the same time, the products developed here do not compromise efficiency when compared to interest-based products.

The Islamic-compatible contracts that we are testing in this paper are based on profit-loss-sharing (PLS). The use of PLS contracts has traditionally been minimized in Islamic banking due to their inherent risks (such as enterprise failure, adverse selection and moral hazard) (El-Gamal 1997). While the problems of enterprise failure and adverse selection are common for both PLS and interest-based finance, moral hazard is the distinguishing risk of PLS finance. Therefore, our paper focuses on comparing moral hazard behavior (not repaying the loan when it should be repaid) between these two types of funding, rather than adverse selection (selecting the wrong individuals, or the wrong projects, to be funded by the loan)..

In this regard, El-Gamal (1997) notes that Islamic banks over-rely on non-PLS contracts (such as: leasing, cost-plus and deferred payment sales), while using an accounting interest rate for their bookkeeping. In a more recent study, Chong and Liu (2009) show that less than 1% of Islamic banking operations in Malaysia are PLS-based products and thus, most of the operations are interest-based or -pegged, which makes Islamic banking very similar to the conventional one. On the worldwide level, Dar and Presley (2000) cite agency problem as one of the main reasons behind the lack of PLS in Islamic banking. However, they confirm that there is no theoretical reason to make us believe that PLS is inherently less efficient than interest-based contracts.

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[1] Assistant Professor of Finance and Economics at Durham Business School, Durham University, UK. Visiting Scholar at Rice University, USA.
[2] Professor of Economics, University of Texas at Dallas.

In this paper, we develop and test Islamic-compliant microfinance contracts that are based on PLS. We use laboratory experiments as a "testbed" or "wind-tunnel" for these contracts (Plott 1987). The laboratory can test, at very low cost, the behavioral response to different types of contracts. These contracts can then be adjusted or amended before being used in the field. The laboratory thus serves as an intermediate step between theoretical development and field-testing.

We develop two microfinance contracts which are Islamic-compliant (profit-sharing and joint venture) and compare them with an interest-based loan. Borrowers invest these loans in risky projects, whose outcome is known to them but not to the lender. We examine compliance rates, the rate at which individuals comply with the terms of the loan, in the three contracts under three conditions. A *baseline* condition involves a simple repayment or reporting decision by the borrower. A *follow-up* condition allows the lender to follow up on the decision, and to force collection or audit the project's outcome if appropriate. A follow-up with *penalty* condition also allows the lender to charge a penalty to the borrower if he has defaulted on the loan or misreported the success of his project.

Our results indicate that the Islamic-compliant loans induce at least as much compliance as the interest-based loans in all three conditions (baseline, follow-up and follow-up with penalty), although the differences between the contracts decrease as the possibility of penalty is introduced. We believe that there is great promise for these types of loans in the microfinance context, and discuss strategies for field implementation in the conclusion of the paper.

The paper is organized as follows. Section 2 discusses the practice of Islamic finance, microfinance, and their combination. Section 3 mentions some theoretical challenges that have been identified in the microfinance literature, while Section 4 outlines the main principles and instruments of Islamic finance. Section 5 describes our theoretical model and Section 6 our experimental design. Section 7 presents our experimental results and Section 8 concludes.

2. ISLAMIC MICROFINANCE IN PRACTICE

Islamic banking is in a phase of growth and change. On one hand, Islamic finance is being celebrated as a promising financial industry. Its assets currently exceed $300 billion (compared to $160 billion in 1997) and the market is estimated to be growing at 10-15% per year (*The Economist*, September 4, 2008).

Islamic banking is emerging from its history of being primarily politically driven (especially in Iran, Pakistan and Sudan) and is increasingly motivated by market forces. Islamic banks have been established in non-Muslim countries with Islamic minorities (e.g. the Islamic Bank of Britain) and Islamic branches of Western banks have begun offering Islamic-compliant products (for instance, HSBC Amanah, the global Islamic finance services arm of the HSBC Group). However, Islamic banks have not typically been involved in microfinance. In part, we believe this is due to a lack of research and innovation in how Islamic microfinance might look, in the absence of subsidies and charitable motivations.

Similarly, microfinance has received considerable attention from financial practitioners, researchers and policy makers. Many microfinance products have been designed and offered by political or charitable organizations whose goal is to foster economic development, rather than to realize a profit from the loan. According to de Aghion and Morduch (2005), the norm in microfinance is still subsidization. The UNCDF Bluebook (2005) asserts that more than 95% of microfinance institutions still require subsidies to cover their costs and finance their loans.

The aim of this paper is to combine microfinance and Islamic finance in order to develop

financial products for the poor that are consistent with Islamic law. The literature from each domain mentions the other as a possible candidate for combination.

Islamic finance scholars shyly hint that microfinance should be one of the future and logical fields for the extension of Islamic finance. Zamir Iqbal briefly mentions the importance of applying Islamic finance to microfinance, since Islamic finance promotes entrepreneurship and risk sharing and its expansion to the poor would be an effective development tool (Iqbal 1997).

The Islamic Financial Services Industry Development's (IFSID) Ten-Year Framework and Strategies Report mentions microfinance more elaborately. It argues for expanding Islamic financial institutions to the microfinance field, both for charitable reasons and for legal reasons. In particular, the legal context in most countries means that Islamic financial institutions can more easily offer microfinance products than non-banking institutions. The report envisages that the assets of the Islamic non-banking microfinance institutions will count for almost 8-10% of the total Islamic financial institutions' assets during the next ten years (IFSID 2006).

Despite the call for Islamic microfinance, there has been very little academic research on the topic. There have been even fewer attempts at implementing Islamic-compliant microfinance products, however.

Perhaps the earliest Islamic microfinance attempt in modern times was that of Mit Ghamr banks in Egypt in the early 1960s. This effort was initiated by an Egyptian economist, Ahmed al-Naggar, who had studied in Germany and was influenced by the German system of mutual credit. Mit Ghamr banks were established in villages around the Nile Delta town of Mit Ghamr. Two systems were used for credit. The first system provided petty loans (up to 200 Egyptian pounds),[3] which were repaid over a two-year period. These interest-free loans were intended for the poorest to help with subsistence. The second system was more like traditional microfinance. Larger loans (up to 2000 Egyptian pounds) were lent to entrepreneurs on a partnership basis, in which the funds provided by the bank were invested in a specific project. The financial returns on the projects were shared between the bank and the entrepreneur (the bank's share ranged between 10-50%) and the debt was considered to be repaid after two years.

Mit Ghamr banks started with one branch and expanded to five branches the following year. Its deposits mushroomed by 367.2% in the first few years. However, it was crushed by the state during Nasser's socialist regime, for political reasons (Galloux 1999). Although this program lasted for only five years (1963-1968), it flourished during its short life and it is still mentioned in the literature on Islamic finance as a pioneering program that inspired many modern financial practices.

The second attempt was also in Egypt, but was instead a publicly owned and managed project. The Nasser Social bank in 1971 was established by an initiative of President Sadat and provided interest-free micro-credit loans for small projects on a profit-sharing basis (Iqbal and Molyneux 2005). Although this bank is still in existence, it is not currently a significant course of Islamic-compliant microfinance loans.

Other institutions that are considered by the IFSID Report, as Islamic financial institutions involved in microfinance type transactions, include Modaraba Companies (Pakistan), Qard Hassan Funds (Iran), Al-Rahnu (Malaysia) and Waqf Foundations (Turkey and Indonesia)

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[3] Around US $550 at that time, with the exchange rate of $1= EGP 0.36.

(IFSID 2006). Earlier in 2009, HSBC Amanah announced that it is partnering with Islamic Relief to establish a pilot Islamic microfinance project in Pakistan.[4]

However, all of the institutions mentioned in this section consider their microfinance activities as charitable, and heavily subsidize them, either via almsgiving, corporate social responsibility or by the state. Our goal, in contrast, is to develop Islamic-compliant microfinance products that could be used by the for-profit sector and the non-for-profit self-sufficient sector.

3. CHOICE AND CHALLENGES OF MICROFINANCE

Microfinance involves providing financial services (such as savings and credit) to low-income clients (Arsyad 2006). The literature sometimes distinguishes between microfinance and microcredit, using the latter to refer specifically to small loans, while using the former as a broader term that also includes micro-savings, micro-insurance and providing borrowers with investment advice and marketing aid (de Aghion & Morduch 2005). We will be focusing on microecredit.

It is worth noting that microcredit is not generally less costly or less profitable than credit from conventional banks - it often involves even higher interest rates reflecting the additional risk inherent in these types of loans. Interest rates between 20 percent and 50 percent annually are quite common in the microfinance industry, even in places where annual inflation rates do not exceed 10 percent (Dehejia *et al.* 2009). The difference is that microcredit gives low-income borrowers access to small loans which are not readily available through conventional banks because of the size of the loan and their inability to provide collateral.

Microcredit arrangements are somewhat unique. The transactions are small and short-term. The creditors and borrowers are usually from the same community,[5] so that informal pressure can be brought to bear when it comes time for repayment. Many microfinance arrangements involve group loans (discussed in more detail below), where members are individually and jointly responsible for the loans. This makes the microfinance setting similar to a public good setting, where repayment is similar to contributing to the public good. Many studies refer to the literature on public good provision when analyzing these types of loans.

3.1. Group versus Individual Microloans

An important choice in microfinance is between individual and group-lending arrangements (de Aghion and Morduch, 2005). Group-lending arrangements are the most popular and well-developed. Although individual lending is less popular than group-lending, it is more feasible in urban areas where peer monitoring costs are very high (because individuals are mobile), social punishment for free riders is difficult (and thus group liability is harder to enforce), and dynamism is low (borrowers do not need to return to the same micro-lender for

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[4]A related endeavor was begun by the Pilgrims' Saving Corporation in Malaysia in 1963. They introduced saving accounts that were pure of any contamination of usury aimed at Muslims who intend to perform the annual pilgrimage to Mecca. This corporation later became the Pilgrims' Management and Fund Board in 1969 and is popularly known as Tabung Haji (Iqbal and Mirakhor 2007). It invests the funds that individuals deposit in *sukuk* (Islamic bonds), *mudarabah* (profit sharing) and corporate notes and directly in investment sectors, particularly: farming, construction, property development and services. However, they do not offer microfinance loans.

[5]Although recently, Internet-based microfinance projects have started to flourish (such as Kiva.org and prosper.com). These projects are not constrained to one community or even one region.

subsequent loans). Some previous research (mentioned below) has examined group-lending microfinance contracts; thus we will be focusing on individual-lending contracts.

Within the individual lending setting, loans are often customized to include progressive lending (where the amounts one can borrow increase with repayment), the adoption of repayment schedules (showing the number of payments and dates needed to pay off the loan), public repayments (where repayment history is made public to the local community), the adoption of flexible attitudes to repayment (such as those adopted by Grameen II, which allows renegotiation and rescheduling of the loan before invoking group pressure), and Internet-based microfinance (such as kiva.org, which acts as a mediator between lenders in developed countries and microfinance organizations in the developing world). These attributes of the individual-lending approach (such as public repayments) are particularly aimed at maintaining peer pressure in the individual setting.

Whether the microloan is made to a group or an individual, the main challenge to microfinance is the risk of default.[6] The incentives for default in microfinance are greater than that in conventional credit. Microfinance loans typically do not involve collateral, increasing the incentive to default. In group-lending, this problem is particularly severe, since if one individual does not repay, the others must do so or lose their future access to credit, which sometimes leads to catastrophic results such as the increase in suicidal rates amongst the poor (Hulme 2000). This highlights the fact that group lending is most likely to be successful in environments characterized by low mobility.

A long list of loan characteristics have been identified that might reduce the likelihood of individuals to default. These include incentives (punishments for defaulting, or the opportunity to get future loans), social ties among group members (in a group loan), punishment (either from the institution, or the group), monitoring (either by the institution, or the group), and peer pressure. Interest rates on loans may also affect the likelihood of default.

Previous literature on microfinance has investigated the impact of some of these factors on the likelihood of default. Three empirical studies investigate the effect of group size on default in group-lending contracts. Abbink *et al.* (2006a), investigates the effect of group size on defaulting behavior in a laboratory experiment. They find that increasing the number of group members increases the number of monitors, which discourages default.

Arsyad (2006) examines repayment rates from Village Credit Institutions in Indonesia. These consist mainly of clients who participate in the microfinance projects in Gianyar district in Bali, Indonesia. The study shows no significant correlation between group size and repayment rates, although it stresses the importance of social ties in discouraging default.

Gine and Karlan (2010) find no negative impacts on repayment rates after randomly removing group liability in microcredit. In a field experiment they ran in the Philippines over three-year period, they concluded that micro-lenders might achieve same repayment rates with resorting to group lending. They also highlight the negative features of group lending in terms of creating excessive social pressure and discouraging good clients from borrowing.

Cassar *et al* (2007) and Karlan (2007) study the impact of social capital on group lending. The results of the former study are based on a field experiment in Armenia and South Africa. It concludes that certain aspects of social capital, such as mutual trust and social homogeneity

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[6]A related problem in microfinance, which we do not address here, is that of *adverse selection*. Individuals with less attractive investment opportunities might be differentially attracted to different loan terms. See Gine *et al* (2006) for a discussion.

affect repayment rates positively. However, other aspects of social capital, as measured by simple acquaintanceship with the others in the group, have a little effect on repayments. The latter study uses natural experimental data from FINCA-Peru. It also finds a significant effect of social connections (in terms of cultural similarity and geographic proximity) on higher repayments and higher savings. The unique feature of this data is that group members are not self-selected. They are rather randomly formed on a first-come, first-served basis. Social connectedness influence group performance through enhancing monitoring and enforcement among the group members.

3.2. Interest Rates

Relatively higher interest rates in microfinance have been an issue for debate among policy makers and academics alike. Some have called for a cap on interest rates to avoid exploitation of the poor by microfinance lenders and prevent the poor from falling into deeper debt traps. Others have argued that a ceiling on interest rates will be more harmful for the poor as this will create excess demand of microfinance loans which would enhance rent-seeking behavior in the industry. Impacts of interest rates are not yet to be clear on the different straits of poverty.

In one study, using very high interest rates (200% APR), Karlan and Zinman (2010) estimated the impact of enhancing access to consumer loans in a field experiment in South Africa. They found significant positive effects of expanded access to credit on the overall borrower outcome, in terms of employment, income and food consumption. The marginal loans given through the credit expansion were also profitable for the lender.

Abbink *et al*. (2006b) used laboratory experiments to investigate the impact of interest rates on default in group settings. On the one hand, they find that higher interest rates increase default rates. On the other hand, higher interest rates increase the group's punishment of defaulters. Thus, higher interest rate had a mixed effect on default rates.

Dehejia *et al.* (2009) find that different categories of the poor respond differently to increases in interest rates. They measure the elasticity of demand for microfinance loans in the slums of Dhaka, Bangladesh with respect to increasing interest rates from 2 percent to 3 percent per month. Their findings are based on econometrical analysis of the data compiled by a microfinance organization called *Safe*Save between January 1999 and January 2001, with the change in interest rates happening midway in February 2000. The sample's elasticities were between -.73 and -.88 during the 12 months after the interest rate change. Less wealthy borrowers were more sensitive to the increase in interest rate (with elasticity of -.86) than relatively wealthier borrowers (with elasticity of -.26). Although the lender's financial conditions improved by raising interest rates, this was at the expense of the poorest clients, who began to refrain from taking its loans. Additionally, the authors observe that as a response to the increase in interest rates, borrowers tend to take smaller and more frequent loans, while repaying them more quickly.

3.3. Moral Hazard

Moral Hazard is a main concern in credit markets, in general. It arises because of information asymmetries between the lender and the borrower. However, this problem is more severe in microfinance because of the lack of collateral and the relative high cost of monitoring with respect to the loan size. Several papers have addressed moral hazard, especially in group-

lending settings (as mentioned above). However, few have focused on moral hazard only. There are two types of moral hazard: *ex-ante* moral hazard (adverse selection), which is related to differentiating between high risk borrowers and low risk ones; and *ex-post* moral hazard where borrowers have similar risk levels but would disclose outcomes differently.

Cason *et al.* (2009) use a laboratory experiment to measure the differences in moral hazard between individual lending and peer monitoring (in group lending). They differentiate the cost of monitoring for the peer and the lender. When the cost of monitoring is the same for the peer as it is for the lender, they find that repayment rates in individual lending are higher than those in group lending. However, when monitoring costs are lower for peer monitoring, which is typical in many microfinance settings, group lending becomes more efficient.

In their field experiment in South Africa, Karlan and Zinman (2010) use randomized loan offerings in order to measure moral hazard that is resulting from hidden actions. A sample of micro-borrowers with good repayment histories were selected to receive direct mail offers. Those who accepted the offers were categorized into their relevant risk category by the loan officers, in order to determine the appropriate loan pricing and maturity options for each. Then, they were randomly offered: the mailed interest rate, lower rate, or different dynamic incentive plan. The borrower's hidden effort in repaying the loan is measured by comparing repayments in the different treatment groups. The authors suggest that moral hazard explains 13 percent to 21 percent of default in the sample.

In this study, we focus on default (moral hazard) in situations of individual lending. We assume (as is the case in most countries) that there are no consequences of default for obtaining future loans, either because of competition among providers or a lack of central credit bureau, or both. We compare compliance with the terms of the loan between interest-based and Islamic-compliant contracts.

4. PRINCIPLES AND INSTRUMENTS OF ISLAMIC FINANCE

4.1. Principles

To understand Islamic microfinance, we need a minimal understanding of the principles on which it is based. Four principles are derived from the *Shari'a* laws (Islamic jurisprudence) and are seen by most scholars to form the core of modern Islamic finance.

The first principle, which is the most famous and perhaps the most controversial from a financial point of view, is the prohibition of interest. The accuracy of the term "interest" is questionable in this context, since the Arabic term *"riba"* is usually translated as usury, not interest. However, *riba* does not refer to usury as in modern economics, charging excessive interest rates. The prohibition of *riba* allows for administrative expenses accrued by financial intermediaries and also for compensation for inflation. It does not allow for profits from the sole activity of lending money (a piece of money cannot beget another piece, according to Aristotle) (Iqbal and Mirakhor 2007). Because the prohibition of *riba* does allow for some interest payments (inflation and administrative expenses), prohibition of *riba* (despite of the foreignness of the word) is a more accurate description than prohibition of interest.

The prohibition of *riba* is related to other principles of Islamic finance. The second principle is risk-sharing, which means that lenders share in the profits and the losses of the business they fund. This requires determining profits for these businesses *ex post*, which is not

necessary in an interest-based loan. Prohibiting *riba* and promoting risk-sharing makes the suppliers of funds investors instead of creditors. Sharing of profits is justified because each party takes some responsibility for the economic transaction. The lender is entitled to the profits only because they bear the risk of loss (Iqbal and Mirakhor 2007).

The third principle involves calculations of the time-value of money and sheds light on the wisdom behind banning *riba*. Money, according to *Sharia'a* rules, is only a medium of exchange, as long as it is not invested in productive activities. According to this view, money has no time-value unless it is used in a productive activity. This principle draws a clear distinction between using money for investment and using it for mere lending/consumption (Iqbal & Mirakhor 2007). When money is used for investment it acquires time-value because its usage yields a financial reward. In this situation, the person who provides money for investments has the right to share this reward, whether it is positive (profits) or negative (losses), consistent with the principle of risk-sharing. On the other hand, when money is used to finance consumption or other activities that yield no financial reward, it has no time-value and should be considered as an act of charity. Thus, *Shari'a* recognizes the time-value of money only when it acts as real capital, but not when it is potential capital (Iqbal 1997).

With regards to investments, the prohibition of *riba* follows the principle of the time-value of money. The ban of *riba* is based on the fact that interest is fixed and earned whether the productive purpose to which it is put is successful or not. This makes it a certain profit while the financial outcome (profit or loss) from investing the money is uncertain. Earning a certain reward as a compensation for the uncertain is unjustifiable both morally and economically.

The forth principle is the prohibition of *Gharar*. *Gharar* is, as *riba*, an Arabic term that has no exact English translation. It simply means taking excessive risks and speculative behavior such as gambling. Literally, *gharar* means uncertainty or ambiguity created by the lack of information or control in an economic transaction. A classic example of *gharar* is selling fish that are not yet caught or an unborn calf in its mother's womb. *Gharar* includes any uncertainty related to the quantity, quality, recoverability or existence of the content of the exchange contract (El-Gamal 2006).

Prohibition of *gharar* leads to avoiding transactions involving pure speculation. Consequently, trading in *gharar*-related contracts is prohibited. However, many scholars find that writing certain types of insurance is not characterized by excessive uncertainty (or *gharar)* because the process itself transforms uncertainty to controlled risk.

4.2. Instruments

A number of financial instruments have been devised to adapt the principles of Islamic finance to modern banking. The following three instruments are perhaps the most relevant to the topic of microfinance.

Profit-sharing agreements, *"mudarabah"* is one of the most common PLS financial arrangements. According to this arrangement, the financier provides funds to the entrepreneur to be invested in an economic activity (usually short to medium term projects) for an agreed-upon share of the profit. If the project returns a profit, the profit is shared as agreed. If the project incurs losses, the financier's loses her capital and the entrepreneur loses his effort and time. One of the contracts we will develop and test will be a profit sharing (*mudarabah)* contract (El-Gamal 2000).

A second popular PLS contract involves equity participation *(musharaka). Musharaka* is

a classic joint venture. This contract is a hybrid of partnership and *mudarabah*. The entrepreneur and the investor contribute to the capital and managerial expertise in agreed upon amounts and they also agree on the share of the profits and losses. A second contract we will develop and test will be a joint venture *(musharaka)* contract.

Perhaps the most popular arrangement in Islamic finance is a *"murabaha"* contract. *Murabaha* is a trade with markup (or cost-plus sale contract) used for purchasing commodities and other products on credit. It is usually used for short-term financing. In this contract, the financier (investor) supplies specific goods to the entrepreneur on the condition of deferred payment for a specific period of time. The entrepreneur produces the final product and sells it. The deferred price includes a markup that compensates the financier for the time-value of money, since money in this case is used for investment in a productive activity. To ensure that the money is used for investment, there are conditions to these types of arrangements. One important condition is that the financier must directly obtain (and own) the goods which are given to the entrepreneur, to ensure that the loan is not used for any alternative purpose. The problem with this contract is the similarity between this contract and an interest loan, which made it criticized by many Islamic scholars and also made it unpopular among the Muslim poor (El-Gamal 2006; and Obaidullah and Khan 2008).

There are other forms of Islamic financial instruments that are also widely used in financial transactions. However, these contracts are analogous to well-known conventional financial contracts. *Ijara* for instance is a leasing contract, which is widely used for financing vehicles, machinery and equipment. Other contracts are developed to provide money for sales rather than for entrepreneurial activities. One type is deferred-payment sale *(bay' mu'ajjal)*, in which delivery of the product is executed while delivery of an agreed-upon payment is delayed for an agreed period. Deferred-delivery sale *(bay' salam)* is similar to a forward contract, delivery of the product is in the future in exchange for payment in the spot market. These contracts are not relevant for the microfinance market, and will not be examined here.

5. MODELS

The main question of this research is whether using microfinance products that are compatible with Islamic law will increase the rate of default compared with interest-based products. The Islamic finance contracts mentioned above, especially those that adopt profit-sharing and joint venture, are especially prone to moral hazard.

We constructed a number of game-theoretic models to compare the impact of the different degrees of risk sharing, as stipulated by different microfinance contracts, on repayment rates. The games are one-shot, played between a lender and a borrower.

The lender has the opportunity to make a loan of size L to the borrower, who invests the loan in a productive project. The project is successful with probability p. If it is successful, the project returns αL, where $\alpha > 1$. The borrower knows the true outcome of the project. The borrower then decides whether to repay the loan according to its terms (comply) or not.[7] In the last stage (in some treatments), the lender can follow up, to avoid the case of market failure (Wydick 108, 2009), either by forcing collection of an interest-based loan or by auditing the project in a profit-sharing or joint-venture arrangement, with some probability of success m and at some cost v. Below, we describe the model for each of our three types of loans.

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[7]For simplicity, we control for adverse selection to focus on moral hazard. This assumption is reasonable, as the lender in microfinance contexts has presumably given loans only to the most reliable borrowers.

We define:

L: loan size

R: opportunity cost/cost of capital for the lender

p: probability of the project's success

α: project multiplier

i: interest rate if interest-based loan

s: lender's share in the project if profit-sharing or joint venture loan

v: cost of collection/auditing, $v = \delta L$, $0 \leq \delta \leq 1$

m: probability of successful collection/auditing

5.1. Interest Based Contract

Under this contract, the lender charges interest rate *i*. The contract requires repayment regardless of the outcome of the project (success or failure). After learning the outcome of the project, the borrower decides whether to repay or to default. In the baseline treatment, the game ends here.

In the treatment with follow-up, the lender can attempt to force collection if the loan is not repaid. The bank succeeds in forcing collection with probability *m* and it pays a cost of collection *v*. In the treatment with follow-up and penalty, the borrower is charged the cost of collection *v* if forced collection is successful. It is worth noting that we assume that the cost of forcing collection *v* (or auditing in the other contracts) depends only on the size of the loan *L*, whilst Cason et al. (2009) assume that the cost of monitoring depends on the probability of a successful monitoring. [8]

We calibrate all of our contacts using a zero-profit condition for the myopic lender (Stiglitz 1990 and Wydick 2008), assuming (naively) that borrowers will repay their loans when their projects are a success, and not otherwise.

The lender's zero-profit condition entails that:

$$(1 + R)L = p(1 + i)L$$

$$i = \frac{1 - p + R}{p}$$

These assumptions generate the game in Figure 1.

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The Bayesian Nash equilibrium is (Default, Default, Collect) under the following conditions:

When *m<1*, the borrower's best response is always to Default, whether his project succeeds or fails and whether the lender will attempt to force collection or not. Knowing that the borrower will Default whenever *m<1*, the lender will force collection if:

$$E_L(Default\ Default,\ Collect) > E_L(Default\ Default,\ Don't\ Collect)$$

$$m > \frac{p\delta}{1 + p + R}$$

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[8] As Cason et al. (2009) mention, monitoring can work in different ways in practice. However, since we are concerned with forcing collection/auditing, not monitoring per se, we assume that the higher the stakes are, the higher the cost the bank is willing to pay in order to retrieve its loan.

This is a necessary condition, but not sufficient for the lender to lend. The lender's expected payoffs at node (5) should be greater than her expected payoffs when not lending, which is keeping her capital *L*. Therefore, she should lend and force collection whenever:

$E_L(Default\ Default,\ Collect) > L$

$$m \ge \frac{p(2+\delta)}{1+p+\delta}$$

Then, the equilibrium is:

(Default, Default, Collect) if $m \ge \frac{p(2+\delta)}{1+p+R}$ and *m<1* (when $p < \frac{1+R}{1+\delta}$). Otherwise, the

equilibrium is: *(Default, Default, Don't Lend)*, when: $m < \frac{p(2+\delta)}{1+p+R}$. This means that the

probability of successful (costly) collection should be high enough for the lending to be feasible.

We will choose parameters to induce an equilibrium of (Default, Default, Collect) in this contract, and parallel parameters in the other two contracts.

5.2. Profit-Sharing Contract

In this contract, the borrower must repay the loan only if his project succeeds. However, similar to the interest-based loan, only the borrower knows the outcome of his project. The borrower self-reports the project's outcome (thus determining his repayment requirements).

If the borrower reports that his project has failed and thus does not repay, the lender can choose to audit (or investigate) the outcome of the project. The lender succeeds in its audit with probability *(m)* and pays auditing fees *(v)*. If the audit is successful and the borrower has incorrectly reported the outcome of the project, he must repay the loan (possibly with a penalty *v*).

The lender's share in the project's outcome (*s*) is calculated based on the lender's zero-profit condition, which is:

$(1+R)L = psf(L)$

Assuming that the investment project is divisible and the loan's production function is linear (for simplicity), we can re-write it as follows:

$f(L) = \alpha L$

$\Rightarrow (1+R)L = ps\alpha L$

$\Rightarrow s = \frac{1+R}{p\alpha}, \quad s < 1$

$\Rightarrow \frac{1+R}{p\alpha} < 1$

So, for a profit-sharing loan to be feasible, the probability of the project's success should be large enough ($p > \frac{1+R}{\alpha}$).

Both lender and borrower face the game in Figure 2.
                    --Insert Figure 2 about here--
The Bayesian Nash equilibrium is *(Default, Default, Audit)* when the following conditions hold:
        The borrower's best response is to Default (as long as *m<1/p*), regardless of his project's

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outcome or the decision of the lender. Knowing that the borrower will Default whenever $m < 1/p$, the lender will Audit (at node "7") if:

$$E_L(Default\ Default,\ Audit) \geq E_L(Default\ Default,\ Don't\ Lend)$$

$$m \geq \frac{2 + \delta}{1 + p + R}$$

The lender will audit as long as: $m > \dfrac{2 + \delta}{1 + p + R}$ and $m \leq 1$.

We will choose parameters to induce an equilibrium of (Default, Default, Audit) in this contract, and parallel parameters in the other two contracts.

5.3. Joint Venture Contract

This model is the same as profit-sharing, except that the borrower contributes capital *(k)* to the investment alongside the lender's capital *(l)*. The lender's share in the project's outcome *(s)* is calculated based on the lender's zero-profit condition (all the other notation is the same as profit-sharing):

$$(1 + R)l = ps\alpha(l + k)$$

$$Then,\ s = \frac{l(1 + R)}{(k + l)p\alpha}\ ,$$

$$for\ s < 1 \ \Rightarrow \ \frac{p\alpha}{1 + R} < \frac{l}{k + l}\ ,\ where:$$

$$l = \rho L,\ 0 < \rho < 1,$$

$$k = \tau L,\ 0 < \tau < 1$$

$$Then,\ s = \frac{\rho(1 + R)}{p\alpha(\rho + \tau)}$$

The equilibrium in this model, shown in Figure 3 is exactly the same as that of the profit-sharing model (Default, Default, Audit) under the same conditions; the borrower will always Default whenever m < 1/p (which means m<1, because p<1) and the lender will only Audit (at node "7") if: $m \geq \dfrac{2 + \delta}{1 + p + R}$.

--Insert Figure 3 about here--

In summary, our three models are parameterized to induce the lender to loan, the borrower to default and the lender to follow up (either via forced collection or an audit) under all three contracts.

6. EXPERIMENTAL DESIGN AND PARAMETERS

Our objective is to compare compliance rates (moral hazard) in the three contracts. The experiment's design thus abstracts away from adverse selection problems; all participants are assumed to be equally deserving of a loan and, indeed, invest the proceeds in the same risky project.

The primary dependent variable of interest is *compliance,* whether the participant complied with the terms of the contract (paying back principal and interest in the interest-based contract, paying back a share of profits if profits are earned in the profit-sharing and joint-venture contracts). Our main control variable is the contractual setting.

6.1. Experimental Design

We examine each of the three contracts under three conditions. In the *baseline* condition, participants choose to comply with the terms of the contract or not, but there are no penalties for noncompliance.   These conditions truncate the game-trees in Figures 1, 2 and 3 after nodes (4) and (5). In the *follow-up* condition, the lender follows up on the contract. For the interest-based contract when borrowers do not comply, lenders attempt to force collection, which succeeds only probabilistically. For the profit-sharing and joint venture contracts when borrowers report that their project has failed (and thus no repayment is necessary), lenders audit the report, which yields an accurate picture of the success or failure of the project probabilistically. If the borrower is discovered misrepresenting the success of the project they are forced to comply with the contract. As in Figures 1, 2, and 3, however, these follow-ups are costly and the cost is borne by the lender. In the *penalty* condition, lenders who are discovered misrepresenting the success of the project both comply with the contract and are forced to pay the costs of follow-up; those costs are loaded into the terms of the repayment. The experimental design thus involves nine treatments; three contract types (interest, profit-sharing, joint-venture) and three conditions (baseline, follow-up, penalty).

We took a number of steps to maximize the number of independent observations we would get. The first design decision was to *automate the lenders*. Participants in our experiment all played the role of borrowers, received loans, invested the loan in projects (and learned about their outcomes), and decided whether to repay their loans or not. The decisions of lenders, while potentially interesting, were not the focus of our study.

As a result, when borrowers paid back loans, they were paying back to the experimenter, rather than to another participant in the room. We believe that this design decision might have had the impact of lowering compliance rates in all of our treatments. However, there is no reason to think that it affects one contract or condition differently than another, thus preserving the *differences* between treatments.

A second design decision was to use a *within-subject design*. Each participant faced all nine treatments. This again maximized the number of observations we got from each session, and allowed us to control for individual-specific effects with appropriate statistical tests. However, we were concerned about order effects. We counterbalanced the order in which each participant saw the three contractual types. Thus individuals were randomly assigned to see one of six potential orders listed in Table 1.

--Insert Table 1 about here--

Although each participant faced the types of contracts in a different order, the order of treatments *within* the contract was always from least complex to most complex: baseline, follow-up, penalty. Thus, for example, a participant in treatment 1, the first row of Table 1 saw the contracts in the following order

Interest   baseline
Interest   follow-up
Interest   penalty

Profit-sharing   baseline
Profit-sharing   follow-up
Profit-sharing   penalty

Joint venture   baseline
Joint venture   follow-up
Joint venture   penalty

6.2. Experimental Parameters

Since we are interested in the frequency with which individual will engage in moral hazard (not complying with the terms of the contract), we chose parameters to maximize the number of times we would be able to observe this behavior. This entailed setting the probability of a successful project high (90%) in order to ensure that participants had sufficient opportunities to comply with their contracts (repay the loan). The outcome for each project was independently drawn for each participant and for each project.

We set the following parameters to be consistent across the nine treatments, and to be consistent with existing investment opportunities (current rates on savings accounts, as of December 2009, do not exceed 3% APY).

opportunity cost of capital (R) = .05 (the cost of capital, or discount rate)
investment's multiplier (α) = 2 (thus successful projects doubled the investment)
cost of forcing collection/auditing (δ) = .05 of the loan size

We sought three further conditions for setting parameters. First, we set parameters to equalize the earnings of the borrower across all nine treatments when the project is successful (90% of the time) and he complies with the terms of the contract. Thus,

Interest-based payoffs = Profit Sharing payoffs = Joint Venture payoffs

$$(\alpha - 1 - i)L \quad = \quad (1-s)\alpha L \quad = \quad (1-s)\alpha(l+k)$$

This condition determined the loan size for the interest and profit-sharing contracts of (L) = 1000, but a different loan size for the joint venture treatments. In joint venture contracts, the lender provides (l) = 330, while participants contribute (k) = 340 out of their own endowments.

Second, we wanted to ensure that when the borrower reported a failure or defaulted on his contract, the lender was indifferent between following-up and not. This ensured that the borrower's behavior in the different treatments would not be influenced by differences in the expectation of the lender's actions. This generated an 80% success rate in collection for the interest contracts, and a 90% success rate of auditing the project's outcome for the profit-sharing and joint venture contracts. Finally, we chose parameters to satisfy the zero-profit condition for the lender mentioned in the theoretical section above. Alternatively, we could have equalized success rates in both interest contracts and the Islamic finance contracts. However, this would have varied the borrower's payoffs when successful and complying between both types of contract. The motivation for complying then, can be confounded by the different payoffs, not by the contract itself, which is what we target.

6.3. Experimental Implementation

The experiment was run in late October and early November 2009 in the CBEES (Center for Behavioral and Experimental Economic Science) lab at UT Dallas. 44 participants completed the experiment, making one decision in each of the nine treatments. Each subject was endowed with 10,000 points at the beginning of the session, and earned (and lost) points based on the outcomes of the risky project, their decisions about compliance, and the probabilistic follow-up actions of their lender. At the end of the experimental session, the participants' point balance was converted into dollars at the rate of 1,500 points = $1. Each participant received a $5 participation fee, plus his earnings in the experiment. Experimental sessions lasted an average of 45 minutes, and average earnings were $18 (including the show-up fee).

Table 2 shows the demographic breakdown of our subjects. Demographics will be included as controls in the analyses below, although our within-subject design also allows participants to serve as their own controls (by comparing behavior from the same person across treatments).

--Insert Table 2 about here--

Participants arrived in the lab, and signed in at the check-in desk. When we were ready to begin, they were randomly assigned to a station number, and led into the lab. They took their seats at their station, and were asked to turn off cell phones and other electronic devices.

The experiment was programmed in zTree (Fischbacher 2007). All instructions were given on-screen and are available from the authors upon request. Participants worked through the instructions at their own pace.

All parameters in the experiment were common knowledge. Participants could take as much time (or as little) as they wished to complete each task. After they had made all nine decisions, they were reminded of their total earnings, and were taken to a post-experimental questionnaire. The questionnaire included demographic questions, as well as questions on religiosity and other attitudes.

After they had completed the questionnaire, participants were asked to please wait quietly. When the group had finished, each participant was individually called (by station number) to the check-in desk to be paid privately and dismissed.

7. EXPERIMENTAL RESULTS

Our primary variable of interest is compliance rates; the rate at which individuals comply with the terms of their contract. Recall that our experimental parameters are chosen so that individuals have no financial incentive to comply. Thus compliance represents a voluntary costly action. Table 3 depicts compliance rates in the nine treatments.

--Insert Table 3 about here--

We begin by comparing compliance rates across the treatments using nonparametric tests.

Result 1: Compliance rates vary significantly by contract (interest, profit-sharing, joint venture), at least in some treatments.

Figure 4 depicts the proportion of compliance decisions in the nine treatments. A *t*-test between proportions demonstrates that compliance rates are significantly higher in the joint venture contract than in the interest contract in both the *baseline* and the *follow-up* conditions. In the *follow-up* condition, both profit-sharing and joint venture contracts yield significantly more compliance than interest contracts.

--Insert Figure 4 about here--

Result 2: Compliance rates do not vary significantly by treatment (baseline, follow-up, penalty).

Comparing compliance rates within contract across treatments yields directional but not statistically significant results. Compliance in the joint venture contract remains constant (45%) regardless of treatment. While we see some increase in compliance in the profit-sharing contract (36% in baseline to 45% in the other two treatments), these changes are not statistically significant. We similarly see increases in compliance rate in interest contracts as treatments change (23% in *baseline* and *follow-up*, 34% in *penalty*), but these changes are themselves not statistically significant.

7.1. Regression Analysis

Similar but more statistically significant results are obtained using panel data regression techniques. We begin with logit regressions, where the dependent variable is 1 if the individual complies with their contract, and 0 otherwise. We use clustered standard errors at the individual level. In addition to treatment, we include controls for order effects, demographics, and religiosity. The results are shown in Table 4.

--Insert Table 4 about here--

This analysis supports Results 1 and 2 described above. Coefficients on profit-sharing and joint venture contracts are consistently and significantly positive, demonstrating that even in the presence of controls, compliance rates are higher in these contracts than in the interest contract. However, there are no significant differences between the profit-sharing and the joint-venture coefficients, again consistent with the nonparametric test results above.
We find directional but not statistically significant effects of treatment. Compliance rates are higher in *follow-up* and *penalty* conditions than in the *baseline*, but those differences are not statistically significant, nor are the differences between *follow-up* and *penalty*.

These results are robust to controlling for the order in which participants saw the three types of contracts. However, some of those order effects are themselves significant. In particular, compliance rates are highest when the interest loan is in between joint venture and profit-sharing. This suggests that having experience with a joint venture or profit-sharing influences behavior in other domains, and is a topic worthy of future research.

Results 1 and 2 are also robust when controlling for individual characteristics although, again, some of these characteristics are themselves significant. For example, women are significantly more likely to comply with the terms of their contract than men, consistent with previous literature (and current practice) in microfinance of focusing on women as recipients of microloans (de Aghion and Morduch 2005). While the results on religion are themselves somewhat muddled (due to the low numbers of individuals self-reporting various religions), the coefficient on religiosity is positive and statistically significant. Participants who attend religious services are significantly more likely to comply than those who do not.

A second set of regressions provides a robustness check for our result. We use logit regressions with fixed effects for individual, order or treatment. The results are presented in the appendix as Table 5 and are the same as those from previous analyses; significant increases in compliance rates for profit-sharing and joint venture contracts over interest contracts, directional but insignificant differences between profit-sharing and joint venture contracts, no significant differences between treatments (baseline, follow-up, penalty), higher compliance rates for women and those who attend religious services.

7.2. Within-Subject Tests

Our analyses up until this point have not leveraged the additional power available due to our within-subject experimental design. In this section we categorize individuals based on their compliance decisions in the different treatments.

Some participants always comply (7%) and others never comply (also 7%). However, many of our participants (86%) complied in some settings, but not in others. We analyze the compliance behavior of these individuals, to identify systematic changes. We compare the distributions of compliance in the various treatments against the baseline hypothesis of random actions using a *t*-test of proportions. Results are reported in Figure 5, panels a, b and c.

Figure 5a shows the percentage of individuals who change their compliance behavior between the interest and profit-sharing contracts. In the baseline treatment, 21% of individuals comply with the profit-sharing contract but not the interest contract, while 7% of individuals comply with the interest contract but not the profit-sharing contract. This pattern is marginally different than what would be expected if individuals were making their decision randomly (p=.0744). We see a similar but statistically significant difference in the follow-up treatment (p=.0049), but no significant effect in the penalty treatment (p=.1928).
We see the same pattern of results when comparing interest and joint venture contracts in Figure 5b. In the baseline treatment, 30% of individuals comply in joint venture but not in interest contracts, while only 7% of individuals comply in interest contracts but not in joint venture contracts. These are again significantly different than what would be expected with random compliance patterns (p=.0055). Similarly significant differences are seen in the follow-up treatment (p=.0098), with directional but insignificant differences in the penalty treatment (p=.2092).

Finally, in Figure 5c we see individuals are no more likely to comply in profit-sharing contracts and not in joint venture contracts than vice versa (p=.2770 in baseline, p=1.000 in follow-up, p=1.000 in penalty).

--Insert Figure 5 about here--

In summary, the analyses in these two sections demonstrate our two main findings. Nonparametrics, panel regressions and within-subject analyses demonstrate that individuals are more likely to comply in joint venture and profit-sharing contracts than in interest contracts, especially in our baseline and follow-up treatments.

7.3. Lender's Earnings

A final analysis addresses a different question; which contracts should a lender choose to offer? Although the experimental parameters were chosen to induce zero profits for lenders when borrowers repay their loans when their project succeeds and default when it fails, behaviorally borrowers often deviated from this strategy. Given the actual behavior of borrowers, how much profit did lenders earn in the various conditions?[9]

For this analysis, we calculate the lender's return on investment (ROI) (% of borrower's repayment amount minus auditing or collection costs / loan principal).   These returns are shown in Table 6 and depicted in Figure 6.

--Insert Table 6 about here--

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[9]As a reminder, none of our experimental participants acted as lenders in the experiments. This analysis calculates how much a single lender would have earned had they been facing all our experimental borrowers as a portfolio of loans.

--Insert Figure 6 about here--

As might be expected, lender's earnings are primarily driven by their opportunity to (probabilistically) collect on a defaulted loan. Thus earnings are higher in the follow-up and the penalty treatments than in the baseline treatment, although there are no significant differences between the follow-up and penalty treatments. Earnings are not significantly different between the three contracts, either within each treatment or when pooled across all treatments.

In summary, we find that compliance rates are significantly higher in profit-sharing and joint-venture contracts (Result 1). We find directional but not significant differences in compliance rates between the baseline, follow-up and penalty treatments (Result 2), although lender's earnings are significantly higher when they can probabilistically force collection (in follow-up and penalty) than when they cannot (in baseline).

8. CONCLUSIONS

This paper provides an experimental test of Islamic-compliant microfinance contracts. While there have been scattered endeavors to establish Islamic microfinance projects in the field, no previous research has compared the performance of Islamic-compliant loans with traditional interest-based loans.

In our setting, the lender gives money to an individual borrower under different contractual agreements (interest, profit-sharing and joint venture). The borrower invests it in a risky project, which doubles the investment with a 90% chance. The outcome of the investment is known only to the borrower, who decides whether to comply with the terms of the loan, or not. In the baseline treatment, this is the end of the game. In the follow-up treatment, the lender can expend resources to force collection (of the interest loan) or audit the outcome (of the other loans). Collection / auditing is successful only probabilistically, in which case the borrower is forced to comply with the loan terms. In the penalty treatment, the borrower pays the cost of the follow-up activities when he complies with the loan terms. Our setting thus controls for adverse selection and instead focuses on moral hazard.

We choose parameters for these models so that borrowers have an incentive to default, regardless of contract or treatment. Our measure of interest, then, is the proportion of individuals who voluntarily comply with the terms of the contract.

We find that compliance is significantly higher in the Islamic-compliant contracts than in the interest contract. In the baseline treatment, compliance in the joint venture contract is significantly higher than in the interest contract. In the follow-up treatment, both profit-sharing and joint venture contracts have significantly higher compliance rates than the interest contract. In the penalty treatment there are no significant differences between the contracts. We also find that women comply more than men; this agrees with common wisdom and practice in microfinance. Further, religiosity increases compliance rates.

We believe that the improved performance of profit-sharing and joint venture contracts over interest contracts has to do with their perceived fairness. In particular, these contracts do not require individuals to repay their loans when their projects fail. As a result, participants feel more obligated to comply with the terms of the contract when their projects succeed. This condition (risk-sharing) characterizes many Islamic-compliant contracts, not simply the ones we tested here.

All research has limitations, and this paper is no exception. Our experimental economics methodology can provide a useful testbed for contracts like these, but a true test will need to follow in the field. Our participants are students, not farmers or microentrepreneurs, and while

we believe that individual reactions to different contracts are likely to be universal, this is an empirical question that can be answered only with data. While the experiment involved small-stakes loans for real money, the project's outcome was randomly determined (within five seconds) with no input from the borrowers. In contrast, in the field, the likelihood of success of a project depends (at least in part) on the effort individuals expend. Now that these contracts have performed well in the lab, future work in the field will provide a stronger test of their suitability.

The results of this research can be useful in both Islamic banking and microfinance. Islamic banking has minimized its use of profit-sharing and joint venture contracts due to concerns about moral hazard. This research suggests that moral hazard may not be as serious a problem as was feared; we find that even with no incentive for repayment 45% of borrowers complied with the terms of their joint venture contract. Furthermore, the level of moral hazard in profit-sharing and joint venture contracts is comparable to (and perhaps somewhat less than) the level in interest contracts. This research thus opens the door for Islamic banking to reconsider the use of these contracts.

In microfinance, our results suggest that profit-sharing and joint venture contracts might be useful tools for both the Muslim and the non-Muslim population. Among Muslims, it will increase the pool of potential borrowers. Among non-Muslims, these contracts may yield greater interest and compliance rates than interest contracts currently in use.

We hope that this research will encourage microfinance scholars and practitioners to consider new and innovative contractual designs. Microfinance has the potential to significantly alleviate poverty, but to accomplish this goal the field needs to cater for different tastes and different levels of poverty. Therefore, varying the choices offered and whether they Exploring and testing alternative contractual types, in the lab and in the field, can help in this move.

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