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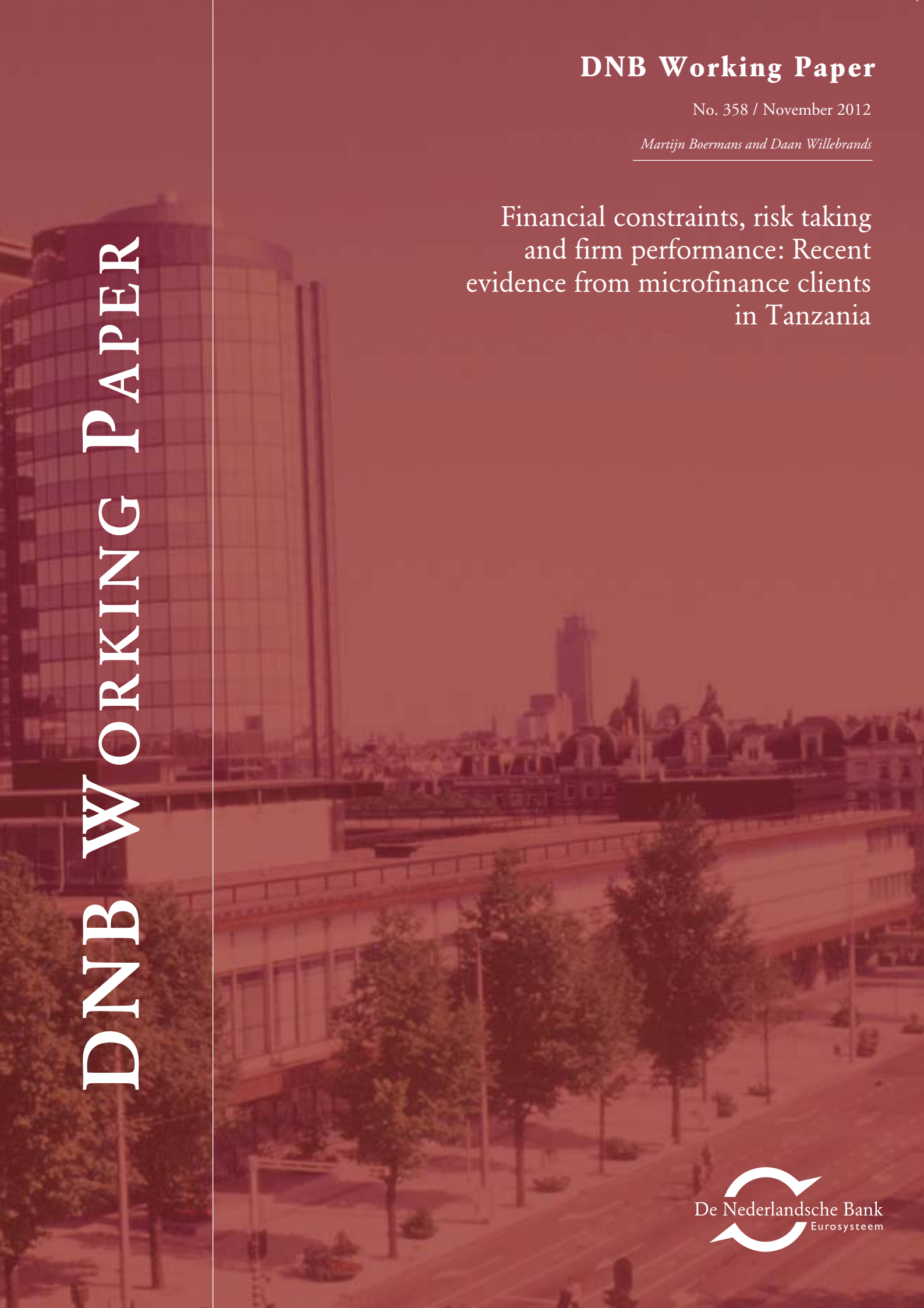

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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Financial constraints, risk taking and firm performance: Recent evidence from microfinance clients in Tanzania

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Abstract

Financial constraints and risk taking are two well-established determinants of firm performance, however, no research analyzes how these variables are connected in the context of a high risk environment. Using data from microfinance clients in Tanzania, we derive a novel financial constraints measure and incorporate a psychometric risk taking scale. Results confirm the importance of access to finance and risk attitudes for business development. Also, we provide preliminary evidence for an interaction between financial constraints and risk taking. Financial constraints "throw sand in the wheels" and protect risk taking entrepreneurs from the negative impact of risk taking on microenterprise performance.

Keywords: micro-credit, access to finance, risk attitude, entrepreneurship, Africa.

JEL classification: D22, G29, O16.

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1. Introduction

Microenterprises represent a large part of the economy in developing countries (De Mel et al., 2009; Masakure et al., 2008; McKenzie & Woodruff, 2008; Nichter & Goldmark, 2009). The abundance of microenterprises is often attributed to the existence of financial constraints as they hamper firm growth. Financial constraints refer to the inability of firms to obtain funds for profitable investment projects, which results in inefficient allocation of resources and decreased firm performance (Banerjee et al., 2009; Claessens & Tzioumis, 2006). Not surprisingly, many entrepreneurs from developing countries report financial constraints as a key obstacle to their daily business operations (Ayyagari et al., 2008; Beck & Demirgüc-Kunt, 2008; Dethier et al., 2011; Sleuwaegen & Goedhuys, 2002; Rijkers et al., 2010). Typically, firms that are financially constrained cannot obtain loans from banks, hold little savings, underinvest, and show poor performance. One of the reasons why many firms in developing areas face such severe financial constraints is the high risk environment in which these firms operate. Banks are unwilling to operate in these areas because their traditional loan products cannot fill the institutional voids.

To overcome this problem, microfinance has been highly popularized as an instrument to tackle financial constraints in risky environments over the past decades. The notion of giving micro-credit to the poor as development strategy was brought under public attention by Mohammed Yunus who in the late 1970s launched the successful non-profit Grameen Bank in Bangladesh (e.g. Hermes & Lensink, 2007, 2011; Karlan & Morduch, 2010; Khandker, 2005). Recently studies have attempted to analyze the effect of microfinance on firm performance (e.g. Banerjee et al., 2009; Coleman, 2006; Kaboski & Townsend, 2012; Karlan & Zinman, 2009). In this paper we study the effects of access to finance on firm performance. By using information from a microfinance institution (MFI) we obtain a new estimate for financial constraints based on loan cycle data. We take up a suggestion by Banerjee and Duflo (2008) and argue that financially constrained entrepreneurs borrow as much as possible at the MFI in order to overcome their liquidity needs. Our focus lies on the performance of microenterprises from Tanzania with access to credit through a MFI.

Access to finance is, however, not only relevant for investment but also for coping with shocks Entrepreneurs who are financially constrained are less able to mitigate the adverse effects of a negative shock (Castro et al., 2009; Dercon, 2008; Vereshchagina & Hopenhayn, 2009). This reduces the performance of their microenterprise. The likelihood of experiencing a negative shock has to do with the external environment, but also with the degree of risk taking by the entrepreneur. Taking risks allows the entrepreneur to exploit profitable new investments, and is therefore often seen as an essential part of entrepreneurship (Begley & Boyd, 1987). But taking risks also leads to a larger probability of facing an unfavourable outcome. The willingness to take risk depends to a large extent on the attitude towards risk by the entrepreneur. The performance of microenterprises is thus influenced by the (lack of) available coping mechanisms and the risk attitude of the entrepreneur.

So far there has been little research on the relationship between financial constraints, risk taking and firm performance. We introduce two opposing views on how the presence of financial constraints affects the impact of risk taking on firm performance. First, greater risk taking is associated with a higher probability of a large negative outcome, given that the variance in the portfolio increases with greater risk taking. Entrepreneurs who are financially constrained cannot mitigate the effect of a negative shock. Therefore, the adverse effect of risk taking on firm performance is amplified by being financially constrained. The second view holds that financial constraints inhibit entrepreneurs to take on risk in the first place, as they are unable to invest in their business. The effect of risk taking on firm performance will therefore be less pronounced. The impact of the interaction with financial constraints depends on the whether the direct effect of risk taking on firm performance is positive or negative. If the direct effect is positive, financial constraints inhibit the entrepreneur from making profitable investments. On the other hand if the direct effect is negative, financial constraints will reduce the exposure of the entrepreneur by limiting its ability to invest in risky projects.

It is often assumed that risk taking has a positive impact on performance, as risk is rewarded in the form of a risk premium. Given that most individuals are risk averse, they need to be compensated in order to induce them to take on risk. Other

explanations for risk taking by entrepreneurs have been suggested. Entrepreneurs may be overconfident about their abilities (Koellinger et al., 2007), they may have a flawed understanding of the uncertainties in the market (Kraus et al., 2012) or they may try their luck when they have an outside option available to fall back on (Vereshchagina & Hopenhayn, 2009). In such cases risk taking does not yield a risk premium and does not lead to better performance. The empirical literature finds mixed results for the effect of risk taking on firm performance (e.g. Rauch et al., 2009; Zhao et al., 2010). A small number of empirical studies suggest that the impact of risk taking on performance is negative in risky environments (Kraus et al., 2012; Tang & Tang, 2007; Willebrands et al., 2012). The risky environment of developing countries is marked by greater uncertainty as the market place is less well institutionalized, leading to investment decisions based on imperfect information and the absence of a risk premium.

Using a sample of 615 entrepreneurs who are clients of a MFI in Tanzania, we analyze the effects of financial constraints and risk taking on firm performance. The results show that financial constraints and risk taking have a negative impact on firm performance. Our empirical outcomes suggest there may be a positive interaction effect between financial constraints and risk taking on firm performance, although the effect is not significant at the standard levels. This preliminary evidence implies that in presence of financial constraints, the negative impact of risk taking is reduced. Financial constraints in general hamper firm performance, but they also mediate the negative effect of risk taking. Our analysis suggests that increasing access to finance may create larger performance heterogeneity among entrepreneurs with different risk attitudes. The results imply that increasing overall access to finance may have unintended consequences, because some entrepreneurs that are empowered by micro-credits may misuse such funding.

The remainder of the paper is organized as follows. Section 2 provides background literature on the relationship between financial constraints, risk taking and firm performance. In particular, a theoretical outline stipulates how financial constraints and risk taking interact and affect microenterprises in risky environments. Section 3 describes our dataset and presents the estimation strategies. Section 4 gives the

results and Section 5 provides findings based on matching techniques. Section 6 concludes.

2. Theoretical background

Financial constraints, microfinance and firm performance

Firms that are financially constrained have insufficient or no access to finance. Financial constraints are a significant problem for microenterprises and their business operations. Using firm surveys across 51 countries, Love and Mylenko (2003) show that countries with greater financial development have fewer financially constrained firms, suggesting that this topic is particularly pertinent in the context of developing countries (Carreira & Silva, 2010). Not surprisingly, in developing areas given the limited number of registered firms and low banking outreach, microenterprises rank financial constraints as the most important obstacle for their operations (e.g. Ayyagari et al., 2008; Cull et al., 2009; Dethier et al., 2011; De Mel et al., 2011; Rijkers et al., 2011).

Evans and Jovanovic (1989) provide a simple model to explain why financial constraints hinder entrepreneurial start-up and reduce firm performance (see also Ahlin & Jiang, 2008; Banerjee et al., 2009). In this framework, financial constraints give rise to two inefficiencies. First, entrepreneurs with high entrepreneurial abilities cannot set-up their own firm because they have too little assets and instead opt for wage labor. This mechanism has received wide empirical support (e.g. Black & Strahan, 2002; Paulson & Townsend, 2004). A second inefficiency that arises from financial constraints in the Evans and Jovanovic model is that there are firms that are willing to invest more in capital, but cannot, and underinvest which reduces the performance. Empirically this also has been confirmed (Bigsten et al., 2003; Fafchamps, 2000). Hence, financial constraints prevent firms from investing the optimal amount in their enterprises, and depress growth, productivity and firm survival (see Carreira & Silva 2010; Musso & Schiavo 2008; Parker & Van Praag, 2006). Indeed, several studies highlight that microenterprises from developing countries can potentially earn high returns (Banerjee & Duflo, 2008, 2010; De Mel et al., 2008, 2009, 2011; Grimm et al., 2011; Kremer et al., 2010; McKenzie et al., 2006, 2008; Udry & Anagol, 2006). For example, using firm-level data from 18 OECD countries, Buera and colleagues (2011) show that financial constraints have a negative

effect on labor productivity. Rijkers and others (2010) find that better access to credits enhances productivity among manufacturing firms in Ethiopia. Combined, evidence suggests that entrepreneurs who can overcome financial constraints are able to improve their firm performance (Beck et al., 2006; Masakure et al., 2008; Sleuwaegen & Goedhuys, 2002).

One of the reasons why many microenterprises in developing areas face severe financial constraints is the high risk environment in which these microenterprises operate (Collier & Gunning, 1999). Substantial idiosyncratic and common risk, and, a lack of coping mechanisms lead to large fluctuations in income (e.g. Dercon, 2002; Dercon & Krishnan, 2000). Microenterprises that require insurance cannot obtain such protection because traditional banks are unwilling to operate under these conditions. The poor are often trapped in a vicious circle: generating income at a subsistence level makes it difficult to accumulate savings or other assets, which disables them either to invest in productive resources or to gain access to credit in formal capital markets (Coleman, 1999; De Weerdt, 2010). In theory, lending institutions can ask for collateral to reduce this issue, but loan collateralization is problematic in many developing areas, and especially difficult for microenterprises (Ghatak & Guinnane, 1999). When capital markets function poorly because credit contracts are not easily enforced, capital fails to reach the most productive investment opportunities, leading to lower returns for financially constrained microenterprises (Banerjee & Duflo, 2008; Dercon, 1996). The high risk environment also leads to high interest rates, due to the cost of getting loans repaid (Banerjee & Duflo, 2010; Dehejia et al., 2012). This further gives rise to financially constrained microenterprises, since investment projects with good returns are restricted by high discount rates.

Using novel lending products, microfinance institutions (MFIs) are able to overcome the problems related to the risky environment and make money available to those that are traditionally "unbankable" (no collateral, no credit history) (Armendáriz de Aghion & Morduch, 2005). Typically MFIs are designed similar to the Grameen Bank model. After entrepreneurs voluntarily form a group, the MFI grants a loan to each entrepreneur. Under joint liability, other group members co-guarantee each others' loan and are expected to meet regularly for partial instalments of the group

loan. Loans are generally due in about six months. If the group does not meet its collective responsibility to repay all of its members' loans, then each group member is denied future credit. Typically, in such a sequential lending structure the first loan has the same (small) amount for all members, and for each subsequent loan cycle, the entrepreneur is entitled to borrow a larger amount. Making groups liable for the losses of their members reduces the cost of monitoring for the lender, as entrepreneurs are supposed to be better informed and able to exert social pressure on other group members. Members are well placed to judge the creditworthiness and to observe the actions of their peers, thus mitigating the problems of adverse selection and moral hazard (Coleman, 1999, 2006; Ghatak & Guinnane, 1999; Hermes & Lensink, 2007; Morduch, 1999). In addition, entrepreneurs have an incentive to repay because in the next loan cycle they can obtain more financing (Armendáriz de Aghion & Morduch, 2005; Cull et al., 2009; Karlan & Morduch, 2010).

Microfinance may contribute to income growth by increasing investments in income generating activities and possible diversification of sources of income, which reduces the entrepreneurs' vulnerability. As argued, without access to credit, entrepreneurs can undertake only a limited number of opportunities, and as a result their firms stay smaller, grow slower and cannot improve productivity.[1] Interestingly, most empirical studies analyze the impact of microfinance on social outcomes and consumption, and, only recently, studies attempt to demonstrate its impact on firm performance (c.f. Banerjee et al., 2009; Coleman, 2006; Dupas & Robinson, 2009; Fafchamps et al., 2011; Kaboski & Townsend, 2012; Karlan & Zinman, 2009). For India, Banerjee and colleagues (2009) find no effect of microcredit on the profits of the microenterprise, but show increased investments in durable goods. For Thailand, Coleman (2006) shows that microfinance raises the number of assets held by the entrepreneur and increases sales. Kaboski and Townsend (2012) show that Thai

[1] In a framework related to the Evans and Jovanovich model, Ahlin and Jiang (2008) also apply an occupational choice model where microfinance augments the credit market to foster entrepreneurship by expanding the choice of workers who could otherwise only have subsistence wage jobs. Before the introduction of microfinance, workers are financially constrained and cannot opt out of subsistence wages to start-up their own business. The introduction of microfinance turns high ability workers into entrepreneurs, which improves their income. The reduced supply of wage labor also increases the wages of the remaining workers and hence microfinance reduces inequality. The general increase in wages lowers entrepreneurial profits and consequently may raise the attrition of unsuccessful entrepreneurs from running a "full-scale" firm with modern technologies. Microfinance can also lower long run growth, because some of the new entrepreneurs switch away from modern technologies.

entrepreneurs that receive microfinance increase profits and income but have lower asset growth rates. For Kenya, Dupas and Robinson (2009) find that access to financial services increases the level of productive investments by entrepreneurs. For Ghana, Fafchamps and colleagues (2011) show that cash grants have no effect on profits, although in-kind transfers raise profitability of microenterprises. For South-Africa, Karlan and Zinman (2009) estimate that consumer credit raises income. Given the early literature on financial constraints and the fact that microfinance is a means to reduce the entrepreneurs' financial constraints as shown in more recent research, we posit the following hypothesis:

Hypothesis 1: Reducing financial constraints has a positive effect on firm performance.

Risk taking and firm performance

Entrepreneurship and risk are two inseparable concepts in the business literature. Entrepreneurship itself is often defined by the bearing of or exposure to risk, separating entrepreneurs from employees and managers (e.g. Begley & Boyd, 1987). As a result, how entrepreneurs deal with risk and their attitude towards risk will influence the performance of their business. The theoretical economic literature often assumes that risk taking behavior of entrepreneurs has a positive effect on performance, even though the mitigation of risk by reducing the exposure to income shocks is regarded as beneficial. In the standard model, in a market where all risks are priced, and investors are generally risk averse, a portfolio with a higher risk level will lead to a higher expected return by earning a risk premium (Pratt, 1964). As such, the level of risk taking by the entrepreneur is expected to have a positive impact on performance (Cressy, 2006).

The business literature on this issue is more nuanced and suggests that risk taking is not always rewarded by a premium. Early work of Knight (1921), '*Risk, Uncertainty and Profits*', introduces a model in which the people who are willing to bear risk decide to become entrepreneur. Knight makes an important distinction between risk and uncertainty, suggesting risk can be captured by probabilities, while uncertainty remains elusive. Under uncertainty it is impossible to gain a correct understanding of the probabilities involved and to make calculated decisions on risk. This points to the

presence of market failure due to uncertainty. Compensation for risk taking is therefore not priced in the market, leading to the absence of a risk premium. Other explanations for the absence of a risk premium come from the literature on entrepreneurship personality and suggests entrepreneurs may be overconfident about their own abilities (Koellinger et al., 2007), frame the situation more positively (Palich & Bagby, 1995) or engage in less counterfactual thinking (Baron, 2000). In such cases there is no need for the existence of a risk premium.

Similarly, the empirical studies are divided over the effect of risk taking on firm performance. The entrepreneurial orientation literature stresses that risk taking is one of the most relevant factors determining firm performance (e.g. Lumpkin & Dess, 1996; Wiklund & Shepherd, 2003). In a meta-analysis of the entrepreneurial orientation framework among 51 studies, Rauch and others (2009) finds a weak positive effect of risk taking on firm performance. Zhao and colleagues (2010), however, find no significant effect of risk taking in their meta-analysis of 60 articles. The studies included in the meta-analyses show no consensus on the size, significance or even the sign of the effect of risk taking on performance. The ambiguous results may be due to the fact that different external situations influence whether the effect of risk taking is positive or negative (Baum et al., 2001). In a non-hostile environment risk taking will be associated with better firm performance, because there will be less need for uncertainty reduction (Lumpkin & Dess, 2001). In contrast risk taking has a negative effect when the environment is turbulent (Kraus et al., 2012) or when the environment is unsupportive of business (Tang & Tang, 2007). Kraus and colleagues (2012) argue that increased levels of unpredictability and dynamism lead to flawed understanding of uncertainty in the market place. This makes risk taking lower firm performance. In similar vein, Tang and Tang (2007) suggest that under uncertainty higher levels of risk taking result in lower firm performance.

The relevance of the environment may also explain the negative effect of risk taking found among entrepreneurs in developing countries. The early study by Singh (1989) shows a negative effect of risk taking on growth among small scale industrial entrepreneurs in Punjab, India. More recently, Willebrands et al. (2012) confirm this result for entrepreneurs on the markets of Lagos, Nigeria. They suggest that it is not

just about taking risks or not, but confirm the idea that good entrepreneurship is associated with taking calculated risk and with reducing the exposure to risk. In developing countries, imperfect credit markets and a lack of bookkeeping, lead to decision making under incomplete information. In such cases there is no longer necessarily a risk premium for investment projects that carry more risk. From the results of the empirical studies on the impact of risk taking on the performance of microenterprises in developing countries we derive our second hypothesis.

Hypothesis 2: Risk taking has a negative effect on firm performance.

Interaction effect between financial constraints and risk taking

In risky environments, risk taking not only has a direct negative impact on firm performance, but may also change the way in which financial constraints reduce the performance of microenterprises. We posit two key perspectives that explain this interaction between financial constraints and risk taking on firm performance.

First, entrepreneurs who are more willing to take risks have a higher chance of experiencing a large negative outcome. When entrepreneurs are also financially constrained, it is difficult for them to mitigate the negative effect of such a shock. Under this condition, the negative effect of risk taking on performance will be more severe. It is therefore expected that risk taking and being financially constrained reinforce each other's negative impact on performance. The impact of the negative interaction between financial constraints and risk taking can be especially large in developing countries, because of the highly uncertain environment where entrepreneurs may experience many and relatively substantial negative shocks. Since there are no insurance markets entrepreneurs have to rely on other means to mitigate the negative impact, but those who are financially constrained do not have excess financial capital or savings to fall back on (Dercon, 1996, 2008; De Weerdt, 2010; Rosenzweig & Binswanger, 1993). Castro and others (2009) show that with sector specific shocks which drive differences in idiosyncratic volatility, in high risk environments with poor coping mechanisms, firms are unproductive and perform worse because differences in risk translate into suboptimal investment rates.

Second, in theory being financially constrained may on the other hand also reduce the negative effect of risk taking on performance. Entrepreneurs who are unable to expand their business by making new investments, will also have to forego seemingly good, but actually unprofitable investments. As risk taking is deemed to have a negative effect on firm performance, risk takers who are unable to invest will be prevented from undertaking projects with poor returns. Hence, financial constraints throw sand in the wheels of risk taking, reducing its negative effect.

To the authors best knowledge these two opposite theoretical predictions have not yet been empirically investigated. It is difficult to quantify the non-linear effects of financial constraints and risk taking on performance, and most studies investigate these topics separately.[2] However, close in spirit is work by Masakure and others (2008) who study the determinants of firm performance in Ghana. Among the explanatory variables included is a measure of financial constraints. They estimate a deciles (quantile) regression model and show that access to finance has a negative (insignificant) impact on performance of microenterprises at the lower performance deciles, while it has a positive (insignificant) effect on the firm in the higher deciles. According to Masakure and others (2008, p. 2750) "bank credit may actually be a hindrance to improved performance for enterprises that are performing badly". They do not explain why this may be so, but we suggest that this may be because those who perform badly are also the ones who take on the most, or too much, risk. If unobserved risk taking explains the lower firm performance, then these results may suggest that risk taking entrepreneurs are protected by financial constraints. This argument would support our second line of thought, that there is a negative interaction effect between financial constraints and risk taking. Still, from a theoretical point of view there can thus both be a negative or a positive interaction effect between financial constraints and risk taking. Empirical analysis could show which effect is dominant.

Hypothesis 3: The interaction of financial constraints and risk taking has an ambiguous effect on firm performance.

[2] Although from different standpoints financial constraints and risk behavior have been linked (see Cressy, 2000; Dercon, 1996; Fischer 2011; Gunning, 2010), unfortunately, prior theoretical research has not analyzed the connection between risk taking and financial constraints in relation to firm performance.

3. Methodology

Context

Tanzania is among the world's poorest countries with a gross domestic product per capita (in PPP) of $1.423. In 2007, the poverty headcount ratio at $2 (in PPP) a day included 88% of the population and life expectancy was only 55 years (World Bank, 2011b). Over the past decade economic performance has improved considerably. GDP growth increased from 3% in the mid-1990s to 6% in 2007. Inflation fell from 27% in 1995 to 6% in 2007. On the World Bank (2011a) Doing Business Indicators 2012, Tanzania ranks 127 out of 183 countries and scores poorly in terms of red tape. Although the economic conditions are improving somewhat, access to credit is currently difficult as there are not many entrepreneurs with official bank accounts and there are still relatively few microfinance institutions (World Bank, 2007; Kinda & Loening, 2010).

Sample

From March to May 2010 data was collected among entrepreneurs who registered with a specific microfinance institution (MFI) in Dar es Salaam, Tanzania. In order to get access to a micro-loan, entrepreneurs voluntarily formed an "Enterprise group" (EG) which consists of four to five members. Entrepreneurs join these groups with other entrepreneurs, who are not relatives. Enterprise groups are united in higher entities, the so-called "Market Enterprise Committees" (MECs) that provide the loans and collect payments at weekly meetings. As is common practice in microfinance, borrowers generally start with a small group loan and can apply for larger loans only after they have repaid their first loan.

The surveys were conducted in Swahili by 15 interview teams who were recruited by a local organization. Interviews took place at the household of the entrepreneur. The target sample consisted of a random draw of 1,660 members from two of the six branches of the MFI. The total number of clients at those two branches was 4,438. The draw was stratified on loan cycle in order to get a decent number of respondents in each category. The sample also only included members who were part of a loan group and who had repaid their first loan. From this sample 674 entrepreneurs were interviewed, leaving 55% of the sampling list not surveyed. The main reason was that it was not possible to reach or trace the members, and six percent refused to

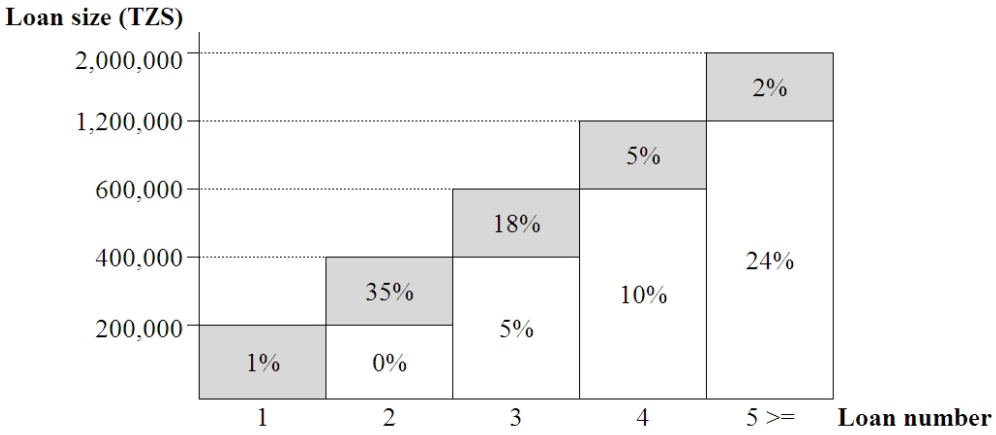
participate. Post hoc analysis shows no systematic differences between in the interviewed and the non-interviewed entrepreneurs on the sampling list in terms of age, gender and loan size. Of the 674 entrepreneurs, 21 members of the MFI did not own a business at the time of the interview and were dropped from the analysis. Due to some missing values on the variables used in this study, the final sample consists of 615 observations (see AIID, 2010).

Operationalization

Financial constraints: For any empirical analysis using data from microenterprises, particularly from developing countries, finding an appropriate measure of financial constraints is difficult (Carreira & Silva, 2010; Claessens & Tzioumis, 2006; Love & Mylenko, 2003). Relevant indicators do not vary sufficiently (e.g. all firms are small) and data is often missing or unreliable (e.g. no auditing requirements or informal business). To overcome this problem we use unique information from the MFI to disentangle which microenterprises are financially constrained and which are not. Specifically, we have data on the number of times entrepreneurs received a loan and the size of the last or current loan. When combined, we can derive a measure of financial constraints because microfinance relies on a specific sequential lending structure, or *loan cycle*.

Following the insight from Banerjee and Duflo (2008) who suggest that financial constraints imply that microenterprises will continuously use extra loans for expansion while unconstrained entrepreneurs do not need this borrowing, we assume that entrepreneurs who are financially constrained will borrow the maximum amount at the MFI given their loan cycle. In other words, financially constrained entrepreneurs need access to finance to improve the performance of their microenterprise and will seek as much credit as possible at the MFI. In contrast, there are some entrepreneurs who do not face financial constraints and therefore choose not to borrow (or less than they possible could given their loan cycle).

Figure 1: Loan cycle cohorts



Note: Percentages relate to the share in the total sample. On April 1, 2010 the exchange rate for $1 was 1,355 TZS.

To construct this novel financial constraints measure, we first use information about the observed number of loans an entrepreneur has received and derive the maximum amount the entrepreneurs are able to borrow within the loan cycle and contrast this to the size of the most recent loan. As depicted in Figure 1, there are five loan cycles and each corresponds to a fixed maximum loan size. The cycle in which entrepreneurs are situated depends on the total number of loans he/she has received. As entrepreneurs build up a sound credit history by fulfilling previous loans, they move up the loan cycles and become eligible for higher loans. We assume that entrepreneurs who are not financially constrained will not always opt for the highest possible loan amount, or choose not to borrow at all, whereas financially constrained entrepreneurs borrow the maximum amount given the loan cycle and continue to ask for new loans when possible.

Given our stratification all entrepreneurs have received two or more loans, except for two individuals (< 1%) who were new applicants. In Figure 1 the grey areas depict the entrepreneurs that borrow the maximum amount possible given their loan cycle. These groups are marked as being financially constrained. The white areas, below the grey, show entrepreneurs that do not borrow (or less than possible), indicating the absence of financial constraints. The first cycle contains entrepreneurs who are new and receive a starting loan of TZS 200,000. In total only two entrepreneurs in our sample fall into this category. In the second cycle (35%), all entrepreneurs receive a second loan equal to the maximum possible amount. In the third cycle (23%), a

majority borrows the maximum amount, while some choose not to borrow or take a smaller loan. In the fourth cycle (15%), only a minority borrows the maximum amount. Finally, in cycle five (26%), even fewer entrepreneurs continue borrowing the maximum amount after having received four or more prior loans, suggesting that the access to finance through the MFI eliminates the financial constraints only after several loan injections of increasing amounts. Based on this loan cycle measure 59% of the entrepreneurs is classified as financially constrained since they ask for a loan that is equal to the highest possible loan amount they can obtain at the MFI given the number of prior received loans.

Because we use a novel indicator of financial constraints, we also use the amount of savings as a measure of financial constraints for control purposes. Typically, financially constrained firms hold little savings (Buera et al., 2011; Carreira & Silva, 2010; Nichter & Goldmark, 2009; Schiantarelli, 1996). Firms with a large amount of savings can utilize this source for investment. Within a realistic time period, entrepreneurs can self-finance business activities by saving or internal funding, thereby overcoming the financial constraints. In order to obtain a measure of the amount of savings, the survey contains the following two questions: "what is your current balance on a formal savings account?" And, "what do you currently have in total in informal savings?" The latter question is essential because many entrepreneurs do not have any official savings and because holding informal savings is very common in developing areas (Grimm *et al.*, 2011). Based on these items we construct a total savings variable. For this measure of financial constraints a lower score indicates that the entrepreneur is more financially constrained.

Risk attitudes: Risk attitude is measured in different ways in the literature. We follow Blais & Weber (2006) because their psychometric scales are easy to understand and do not require high levels of financial literacy. They distinguish between different domains, allowing us to focus on the financial domain that is most relevant to investment decision making. A similar psychometric scale has been applied in a household survey among Nigerian market entrepreneurs (Willebrands et al., 2012). For six different risky actions respondents are asked to indicate how likely they are to take that action on a seven point Likert scale that ranges from 'Extremely unlikely' to 'Extremely likely'.

Table 1: Description of the individual risk taking items

	Mean	S.d.
1. Betting a day's income at a high-stake card game, such as poker	1.38	1.12
2. Investing (Y) in a new business venture	4.52	2.22
3. Betting a day's income on the outcome of a sporting event, such as soccer	1.61	1.44
4. Investing (Y) in shares	3.88	2.01
5. Investing (Y) in a wonder-bank or other scheme that promises you a very high return on savings	4.95	2.07
6. Investing (Y) in a new farming technology	3.81	2.23

Note: Y denotes 10 percent of annual income. The interviewer looked up the reported total annual income from the respondent's main job over the past twelve months and reads out 10 percent of this figure to the respondent.

Two of the original items by Blais and Weber (2006) related to betting on 'horse races' and investing in a 'moderate growth mutual fund' have been replace by investing in a 'farming technology' and investing in a 'wonderbank' to make the items compatible to the local context in Tanzania. Two of the six items refer to betting and the other four refer to investment. The four investment items relate explicitly to an investment of 10% of the annual income of the respondent, which is calculated and pronounced by the interviewer. The two betting items relate to a 'day's income' without the reference to any specific amount. Table 1 lists the six individual risk taking items and shows that the entrepreneurs are highly unlikely to bet whereas they are somewhat likely to take risk by investing. This discrepancy was also recorded in other studies (e.g. Blais & Weber, 2006; Willebrands et al., 2012).

We construct the measure of the risk attitude of the entrepreneurs by combining and taking the means of the six items. The average value among the entrepreneurs in our sample is 3.36 meaning that on average they are "somewhat unlikely" to take risk. This average is similar to that found in several other studies that use the scales developed by Blais & Weber (2006). Table 2 summarizes the average risk attitude scores, variation and sample population among a number of those studies. The similarity of the results suggests that there is no selection bias in our sample with regards to the risk attitude of the entrepreneur, such that it seems unlikely that entrepreneurs with certain risk attitude profiles drop out after the first loan cycle or do not join the MFI.

Table 2: Overview of studies with risk taking scale

Country of study	Mean	S.d.	n	Sample
Tanzania	3.36	0.96	615	Entrepreneurs (non-farming), Dar es Salaam
Nigeria	3.23	1.12	759	Market vendors from Lagos
England	3.11	1.14	172	Random sample, age group 22-35
France	3.39	1.12	30	Farmers from three regions
Italy	2.94	1.15	119	Entrepreneurs and civil servants
United States[1]	3.21	N/A	336	Undergraduate students
United States[2]	3.29	0.80	605	Undergraduate students (psychology)
United States[3]	3.32	1.11	135	Undergraduate students (psychology)
United States[4]	3.43	1.41	203	Associates of local university
Canada[1]	3.44	1.42	187	Random sample, age group 22-35
Canada[2]	3.09	1.50	240	Undergraduate students (psychology)

Note: Similar to Blais and Weber (2006) most studies use a 7-point Likert scale for the investment and betting items as part of the financial domain for the risk taking scale, while those with a 5-point scale have been converted for sake of comparison. The respective statistics come - through personal contact - from Willebrands et al. 2011 (Nigeria), Blais and Weber 2006 (England and Canada[1]), Reynaud and Couture, 2010 (France[2]), Franco and D'Angelo, 2010 (Italy), Johnson, 2009 (United States[1]), Foster et al. 2009 (United States[2]), Christman et al. 2007 (United States[3]), Deck et al. 2010 (United States[4]) and Mishra et al. 2010 (Canada[2]).

Firm performance: Ideally, we like to measure firm productivity because it indicates if firms use and allocate resource inputs most efficiently for productive uses (Bartelsmans et al., 2009; Brandt et al., 2012; Dethier et al., 2011; Hsieh & Klenow, 2009). However, productivity differences across microenterprises in developing countries are difficult to measure because these firms do not provide financial accounts nor is there reliable data on capital inputs (Claessens & Tzioumis, 2006). In such settings it is therefore common to focus on labor productivity instead of firm productivity, which indicates how efficiently labor is used in the production of output, the key input in non-farming, microenterprises in developing countries. This is a suitable measure as many microenterprises use little capital, reducing the discrepancy between firm productivity and labor productivity (Buera et al., 2011; Rijkers et al., 2010). To derive the labor productivity, first, sales are calculated based on self-reported sales of the microenterprises. For each month entrepreneurs indicate whether it was a month with high, average or low sales. Then they are asked to indicate the value of sales in a typical month with high, average and low sales. From these questions the total amount of sales for a year is calculated. By differentiating between high, average and low, the sales take into account the

seasonality which may be an important factor in the performance of many entrepreneurs. Next, output per worker is derived by dividing total sales by the number of employees. The labor productivity is obtained by adjusting the output per worker for the number of months that the microenterprise was opened. We take the natural logarithm to smooth labor productivity. The analysis uses labor productivity normalized by sector. Thus, for a given firm's labor productivity, we subtract the sector's mean labor productivity and then divide this by the sector's standard deviation. This way, our firm performance measure is unaffected by price variation across industries that may drive sales, technological differences across sectors, and other relevant sector differences such as capital intensity (see Buera et al., 2011; Dethier et al., 2011; Rajan & Zingales, 1998; Rijkers et al., 2010).[3]

Table 3 shows that there is a wide variation across sectors in labor productivity, employment, sales and months open. The within sector variation of these measures is in general much lower than in the overall sample. This indicates that the microenterprises within the same sector are relatively homogenous. Furthermore, as expected, the capital intensive sector has by far the highest average sales and labor productivity and includes a range of activities such as ICT shops, music stores, pharmacies, supermarket chains and transport. What these firms have in common is that selling requires a relatively large investment in assets or that they generally have high margins. The lowest average revenue and labor productivity are found in the service sector, which is the least capital intensive and includes barbers, beauty salons and tailoring.

[3] Normalization by sector is becoming more commonly applied in firm-level studies, see for instance Bartel and Harrison (2005), Bartelsman et al. (2009), Brandt et al. (2012) and Van Biesebroeck (2008).

Table 3: Summary statistics for firm performance and productivity

	LP		Firm size		Sales		Months open		
	mean	*s.d.*	*mean*	*s.d.*	*mean*	*s.d.*	*mean*	*s.d.*	*obs*
Capital intensive	15.4	0.9	0.8	2.1	15.3	12.8	11.6	1.4	77
Clothing	15.2	0.9	0.6	1.7	8.1	11.8	11.5	1.2	98
Food	15.3	1.2	0.3	0.6	10.4	16.5	11.8	0.7	101
Restaurants	15.0	0.9	1.3	1.5	9.2	10.8	11.5	1.3	88
Retail	15.3	1.0	0.3	0.6	9.5	12.9	11.5	1.6	81
Services	14.5	1.1	0.7	1.1	4.9	5.9	11.6	1.3	93
Snacks & drinks	14.9	1.2	0.9	1.5	7.8	8	11.4	1.8	77
Total (average)	15.1	1.1	0.7	1.4	9.2	19.9	11.6	1.4	615

Note: sales is measured in millions TZS.

Controls: Previous studies which analyzed the determinants of the performance of microenterprises in developing countries have found a number of recurring significant factors (e.g. Daniels, 2001; Fajnzylber et al., 2006; Masakure et al., 2008; Sleuwaegen & Goedhuys, 2002; Vijverberg, 1991). In order to mitigate omitted variable issues the age of the firm (younger than 2 years), and the entrepreneur's age, gender and education level are included as controls. At the household level we also control for asset wealth based on an *asset wealth* factor of 27 household items (Cronbach's alpha = 0.82; see Appendix A) (Filmer & Pritchett, 2001; Sahn & Stifel, 2000). Note that because we have normalized the firm performance measure we also take the size of the firm measured by the number of employees, number of months the business was opened during the past year and the sector in which the firm operates into account. Because these variables (sales, months open and sectors) are important determinants of performance, the total explained variance in our regressions will generally be lower since they do not feature as independent variables (see Hsieh & Klenow, 2009).

Descriptive statistics

To give a better understanding of the microenterprises we delineate some core features of our data. Table 4 provides the summary statistics of the variables employed in this study, and shows a standard correlation matrix. The average age of the entrepreneurs is 38 years. Two-thirds of the entrepreneurs is female. Two-thirds has completed primary education, and only 7% finished secondary schooling or

more. The majority of the microenterprises has no employees (62%), and only 6% has two or more workers. On average, the firms operate 6.8 years and 18% started less than 24 months ago; the latter we classify as young firms. 85% is opened for the full 12 months, and 97% is opened 9 months or more. The median annual sales are TZS 5 million. The average savings are about TZS 350,000 for entrepreneurs who accumulated saving, where 34% holds no savings.

Estimation strategy

In order to test for the effect of financial constraints and risk taking on firm performance we estimate a standard OLS regression model with Huber-White robust standard errors.

$$(1) \qquad ln\ LP = \beta_0 + \beta_1\ FC_i + \beta_2\ RISK_i + \beta_3\ FC_i{*}RISK_i + \beta_4\ CONTROLS_i + \varepsilon_i$$

where *LP* stands for normalized within-sector labor productivity, the β_1 measures the direct impact of financial constraints (*FC*), β_2 represents the direct effect of risk taking (*RISK*), β_3 measures the interaction effect of financial constraints and risk taking, and β_4 includes the set of control variables and ε_i is the error term.

Table 4: Summary statistics and correlations

		Mean	S.d.	Min	Max	1	2	3	4	5	6	7	8
1	Labor productivity	0	1.00	-3.63	2.71								
2	Loan cycle (*FC*)	59%		0	1	**-0.10**							
3	Savings (in millions)	0.23	0.43	0	3.70	**0.09**	-0.06						
4	Risk taking	3.36	0.96	1	7	**-0.15**	0.04	**0.12**					
5	Young firm	18%		0	1	**-0.12**	**0.15**	-0.01	0.06				
6	Male	34%		0	1	**0.12**	0.06	0.06	0.06	-0.05			
7	Age	37.90	8.58	18.00	75.00	0.01	**-0.15**	0.02	-0.02	**-0.17**	-0.02		
8	Secondary education	7%		0	1	0.03	-0.02	**0.33**	0.06	-0.03	0.04	**-0.11**	
9	Asset wealth	0	0.94	-1.80	4.21	0.05	**-0.14**	0.2	-0.01	**-0.12**	**-0.13**	**0.24**	0.23

n=615. The correlation coefficients that are significant (p<0.05) are highlighted in **bold**.

4. Results

Table 5 provides the results from the OLS regressions related to the direct effect of financial constraints and risk taking on normalized within-sector labor productivity (*LP*). The findings in Column (2) and (5) show that financial constraints (FC), as measured by the loan cycle variable, have a significant negative effect on *LP*. Keeping other things constant, the magnitude of the effect of financial constraints on *LP* is relatively large. On average, an entrepreneur who is financially constrained has 18% to 19% lower labor productivity compared to microenterprises that are not financially constrained. Similarly, using savings, Columns (3) and (6) present a significant negative effect of financial constraints on performance. That is, a one standard deviation decrease in savings is associated with a drop in *LP* by around 21% to 26%. These outcomes are robust after the inclusion of risk taking. The coefficient of determination in all models is quite low compared to other studies on firm performance, but this is due to the fact that especially firm size has a large explanatory power and in our setting is part of the dependent variable. Other studies that analyse labor productivity also find a low r-squared (Hsieh & Klenow, 2009). The results in Table 2 support Hypothesis 1 that financial constraints reduce firm performance.

Table 5 also shows the direct effect of risk taking on the normalized within sector labor productivity. In Columns (3), (5) and (6) we find a robust and significant negative coefficient for risk taking. A one standard deviation increase in the entrepreneurs' risk taking decreases *LP* by 16% to 17%, ceteris paribus. The results demonstrate that successful entrepreneurship is not characterized by high risk taking, but rather by aversion to risk. The findings support Hypothesis 2.

Table 5 further presents the interaction effect for financial constraints and risk taking on the normalized within sector labor productivity. In Column (7) the direct effects of the loan cycle (FC) and risk taking are negative and significant, while the interaction term is positive, but insignificant ($p=0.16$). Although the interaction is clearly insignificant, the interpretation of the sign of the coefficient is that the direct,

negative effect of risk taking is reduced by the presence of financial constraints.[4] The findings in Column (8) with respect to savings as a measure of financial constraints point in the same direction. The direct effects of savings (FC) and risk taking are significant, and, the interaction effect is negative and significant ($p<0.05$). In line with the results of the loan cycle interaction term, it shows that the negative impact of risk taking on firm performance is larger once the entrepreneur holds greater savings. Therefore we find preliminary evidence that there is a negative interaction effect between financial constraints and risk taking (Hypothesis 3). Note this effect is not found with the loan cycle variable.

Figure 2 depicts the marginal effect of risk taking on *LP*, taking into account both the direct effect of risk taking and the interaction with financial constraints. The lines are based on the model in Table 2, Column (6) for the loan cycle measure with one line representing the situation with financial constraints and the other without financial constraints. Because both slopes are negative, higher risk taking is associated with lower firm performance, ceteris paribus. Although the cross-term is insignificant ($p=0.16$), visually, the slope of the line is flatter for those entrepreneurs who are financially constrained, so that this may suggest that financial constraints mitigate the negative effect of risk taking. In addition, at around $RT = 5.5$ the two lines cross, but the place of the intersection is sensitive to the size of the estimated coefficient of the not significant interaction term. A crossing point would suggest that entrepreneurs who are risk averse or moderate risk takers have higher labor productivity when they are not financially constraint. In contrast, high risk takers who are financially constrained would have higher labor productivity than high risk takers who are not financially constrained. Overall this may suggest that entrepreneurs who are financially constrained are protected against making unprofitable investment; this effect is so large for those who take most risk that it dominates the direct negative effect that financial constraints have on firm performance.

Using savings as the measure of financial constraints, Figure 3 shows the same pattern as in Figure 2 but here the interaction effect is significant ($p<0.05$). The slope of the lines increases with the level of savings, that is, lower financial constraints. Having fewer saving reduces the negative effect of risk taking on within sector labor

[4] However, this meaning is unwarranted as the estimated coefficient for the interaction is not different from zero.

productivity. As in Figure 2, the lines intersect around $RT = 5.9$. This means that the entrepreneurs who take little risk benefit most from having higher savings. Although the interaction effects depicted in Figure 2 and Figure 3 is only significant for savings, our findings are consistent with the view that financial constraints throw sand in the wheels of risk taking entrepreneurs, hence reducing the negative effect of risk taking on performance.

Table 5: Effects of financial constraints and risk taking on labor productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Loan cycle (*FC*)		-0.19**			-0.18**		-0.54**	
		[0.0806]			[0.0796]		[0.251]	
Savings			0.21**			0.26***		0.76***
			[0.099]			[0.094]		[0.273]
Risk taking				-0.16***	-0.16***	-0.17***	-0.22***	-0.14***
				[0.039]	[0.039]	[0.038]	[0.055]	[0.042]
FC*RT							0.11	
							[0.076]	
Savings*RT								-0.14**
								[0.069]
Young firm	-0.29**	-0.26**	-0.30***	-0.26**	-0.24**	-0.27**	-0.25**	-0.28**
	[0.113]	[0.112]	[0.113]	[0.110]	[0.110]	[0.110]	[0.110]	[0.110]
Male	0.26***	0.27***	0.25***	0.28***	0.29***	0.27***	0.29***	0.26***
	[0.084]	[0.084]	[0.084]	[0.082]	[0.082]	[0.083]	[0.083]	[0.083]
Age	0.025	0.021	0.023	0.029	0.025	0.026	0.028	0.023
	[0.031]	[0.030]	[0.030]	[0.029]	[0.029]	[0.029]	[0.029]	[0.029]
Age2	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Sec. education	0.034	0.028	-0.074	0.076	0.069	-0.050	0.083	-0.049
	[0.122]	[0.122]	[0.129]	[0.123]	[0.123]	[0.130]	[0.123]	[0.128]
Asset wealth	0.059	0.050	0.046	0.057	0.049	0.042	0.046	0.043
	[0.049]	[0.048]	[0.048]	[0.047]	[0.047]	[0.046]	[0.046]	[0.047]
Constant	-0.48	-0.28	-0.47	-0.03	0.15	0.02	0.30	-0.03
R^2	0.034	0.043	0.041	0.058	0.065	0.068	0.068	0.072

Note: n=615. Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.10.

Figure 2: The interaction between the loan cycle (FC) and risk taking

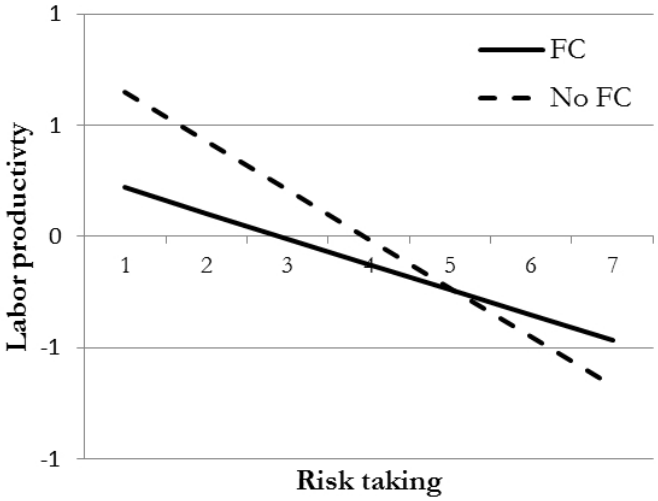
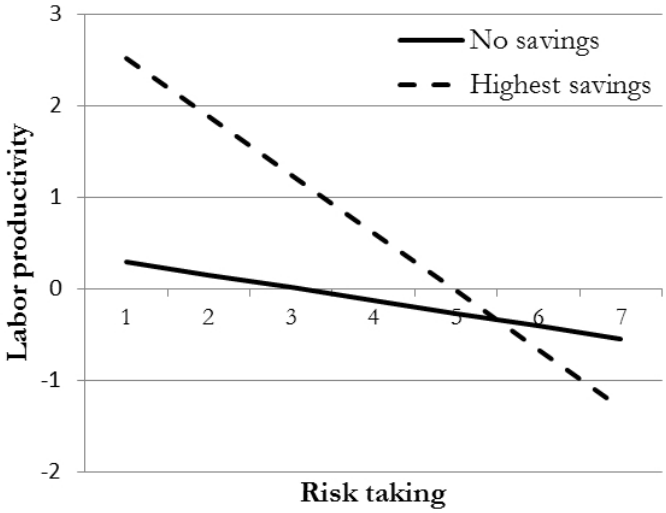


Figure 3: The interaction between the savings (FC) and risk taking



5. Reversed causality

From a methodological point of view we have not taken into account that better performing microenterprises may face lower financial constraints, because more successful entrepreneurs find it easier to access finance either externally or through internal funding. Therefore, financial constraints may lack randomization and there may be biases from simultaneity (e.g. reverse causality, selection bias and measurement error, see Persson & Tabellini, 2005). We would like to rule out any difference in performance that arises because some entrepreneurs will be more likely to have financial constraints than others, something that leads to biased ordinary least square regression estimates (Caliendo & Kopeinig, 2008). In order to mitigate this potential selection bias problem where microenterprises with high performance are less likely to be financially constrained, we apply propensity score matching (PSM) techniques. In this manner we are able to better compare financially constrained entrepreneurs with non-constrained peers that share similar *observable* characteristics (Rosenbaum & Rubin, 1983). If OLS is correctly specified, it is a more efficient method than PSM, however, PSM allows for more direct comparison between individuals and may avoid misspecification issues because it allows for arbitrary heterogeneous effects of the independent variable (non-parametric).

Under the assumption that all relevant differences between those that are and are not financially constrained can be captured by a set of observable variables (selection on observables), we can isolate the 'impact' of financial constraints on firm performance, and obtain reliable and relevant estimates of the size of this effect. One advantage of the data is that we have a relative homogenous group of entrepreneurs since they are all clients at the same MFI in an urban area for at least one year and have repaid their first loan. This means we may already account for certain unobservables, e.g. those with certain entrepreneurial ability may self-select into microfinance borrowing schemes. In addition, we must observe entrepreneurs who are financially constrained and those that are not, that share similar characteristics (common support), otherwise PSM fails (see Heckman et al., 1998; Leuven & Sianesi, 2003). Methodologically speaking, with PSM we compare microenterprises that have the same probability of being financially constrained based on a set of relevant controls, where one group is observed to be financially constrained (treatment group)

and the other group is not (control group). Hence, PSM derives the conditional probability of treatment given covariates (see also Appendix B). Next PSM estimates the 'impact' of financial constraints on firm performance by looking at the average treatment effect on the treated. There are currently no econometric techniques that allow for the inclusion of an interaction term with PSM so we cannot test Hypothesis 3 in this manner. However, if the main effects of financial constraints and risk taking are not driven by selection, then this at least makes it less likely that such bias is present in the estimations with the interaction effect.

The PSM average treatment effects in Table 6 accommodate on our main findings from Table 5. As presented, in the first rows of Columns (1) and (2), measured by the loan cycle, financial constraints have a significant 'impact' on normalized within sector labor productivity. This effect is robust across specifications. The presence of financial constraints reduces *LP* by 22% to 28%, which is comparable to the 18% to 19% lower labor productivity we find for the OLS estimations in Table 5. Table 6 further uses two savings dummies to estimate the impact of savings on performance. Specifically, first we look at a group of entrepreneurs that has no savings (34% has no savings). The results show that not having any savings has a significant negative 'impact' on *LP*. Entrepreneurs without savings have 29% to 34% lower labor productivity compared to peers with similar characteristics, apart from savings. Second, we make a dummy for entrepreneurs who have above average saving (35%). Although the results are weaker, the estimates show that this high saving group has 17% higher labor productivity relative to those with below average saving levels. These results from PSM reconfirm Hypothesis 1 and indicate that the size of the effects found in Table 5 are robust.

Table 6: Impact of FC and RT on labor productivity (ATT)

	(1)	(2)
Financial constraints		
Loan cycle	-0.28***	-0.22**
No savings	-0.29**	-0.34***
Mean savings	0.17*	0.17**
Risk taking		
Risk averse	0.14*	0.22***
Risk taking	-0.34***	-0.32***

Note: Note: n=615. *** p<0.01, ** p<0.05, * p<0.10 based on bootstrapped standard errors (500 replications) using psmatch2 in Stata (see Leuven & Sianesi. 2003). In Column 1 kernel density propensity scores are applied for the matching of the treated and controls. Column 2 is based on nearest neighbour matching (n = 5) with caliper 0.10. The matching is done on a limited set of control variables: male. young firm. secondary education. entrepreneur's age. age squared and asset wealth. Only in Column (2) two treated firms dropped because they are off the common support. See further Appendix B for first stage probit estimations.

In potential, risk taking for its part may increase or decrease with firm performance. It could increase as better performing entrepreneurs have the financial capacity to absorb a large loss (Banerjee & Newman, 1993) or less capitalized entrepreneurs may want to take more risk as they have not much to lose and can fall back on wage employment (Vereshchagina & Hopenhayn, 2009). Risk taking could also decrease as more wealthy entrepreneurs have relatively more to lose and less to gain. Most of the studies which look at risk taking and firm performance do not empirically analyze the issue of causality. For example, Rauch and others (2009) concludes that their results are only about correlation and not causality. To this end we make a first attempt to empirically examine this issue. Because matching requires the use of indicator variables we classify risk averse and high risk taking entrepreneurs as follows: those with a score of three or lower on risk taking are considered risk averse (36.9%); and those with a score of four or higher are grouped as high risk taking (29.4%). The results in Table 6 show that among each specification risk aversion has a significant 'impact' on firm performance. We find that risk aversion leads to an increase in *LP* of 14% to 22%. In reverse, the findings also indicate that risk taking has a significant negative 'impact' on firm performance. Risk taking reduces *LP* by 32% to 34%. These results from PSM reconfirm Hypothesis 2. To our interpretation, it is not greater risk taking per se that is detrimental to performance, but more risk averse entrepreneurs are more successful in risky environments.

6. Conclusion

Access to finance and entrepreneurial behavior are an integral part of economic development. In this paper we formulate two new views on the relationship between financial constraints, risk taking behavior and firm performance in a high risk environment. According to the first view increased risk taking will lead to greater uncertainty, i.e. a higher variance in the outcome. As a result, the chance of experiencing a large negative shock will be higher than under low risk taking. Entrepreneurs that are financially constrained are unable to mitigate the impact of such a negative shock. Financial constraints in this sense reinforce the adverse effect of risk taking on firm performance. The second view holds that financial constraints inhibit entrepreneurs to take on greater risks in the first place. This reduces the effect of risk taking on firm performance. We argue that, although risk taking lies at the basis of entrepreneurship, in risky environments risk taking may lower firm performance. If so, financial constraints reduce the exposure to risks and can prevent entrepreneurs from making investments and therefore also from making low-return investments.

We also present an empirical analysis on the effect of financial constraints and risk taking on firm performance using data on clients from a microfinance institution (MFI) in Tanzania. The results give preliminary evidence that financial constraints have a *positive* effect on firm performance by reducing the adverse effect of risk taking, in line with the second purported view. As risk taking is found to exhibit a direct negative effect on firm performance, financial constraints withhold risk taking entrepreneurs from undertaking unprofitable investments. In this way, financial constraints "throw sand in the wheels" of those willing to take risk and protect entrepreneurs from making low-return investments.

We use a novel measure of financial constraints based on the lending structure of the MFI and also apply savings as an additional measure of financial constraints for robustness. The empirical analysis shows the primacy of access to finance in facilitating the development of the private sector and successful entrepreneurship. We measure the performance of microenterprises using normalized within sector

labor productivity. The estimation results show that entrepreneurs with financial constraints have around 20% lower labor productivity. We conclude that in general financial constraints have an adverse impact on the firm performance, suggesting there is an important role for microfinance institutions to provide credit in developing countries.

This research stipulates the importance of entrepreneurial characteristics. More attention to risk attitudes is called for when optimizing the flows of finance in high risk environments. Contrary to conventional wisdom, based on a psychometric risk taking scale, we find that higher risk taking propensity has a *negative* impact on performance and leads to a decline in labor productivity of more than 30%. Still, risk taking is an essential part of entrepreneurship and is often required to make profitable investments. We contribute to the debate on the role of risk taking in successful entrepreneurship by suggesting that more risk taking may not be beneficial under situations of high uncertainty, or in a high risk environment.

The benefit of our financial constraints measure is that it can easily be replicated by other researchers working with data on MFI clients. Using loan cycle information, financially constrained entrepreneurs will fully use the credit facilities at the MFI by borrowing the maximum amount possible. A potential weakness of the financial constraints measure is that entrepreneurs with high returns are more willing to expand their firm. As such, better performance induces entrepreneurs to borrow more. If that is the case, then microenterprises with high growth opportunities will be marked as financially constrained, because they continue to borrow the maximum possible. This would lead to the counter-intuitive result of a positive association between financial constraints and performance. Such concern is contradicted by the empirical estimates which show that entrepreneurs who take up the maximum possible loan amount actually perform worse.

The sample consists of entrepreneurs who are a member of a MFI and received more than one loan. It is well-known that many microenterprises are financially constrained. We do not imply that those who are not affiliated with a MFI are financially sound. This study cannot unravel what would have happened to the business if the entrepreneurs had not received any loans (Armendariz de Aghion &

Morduch, 2005). The entrepreneurs in the sample may have different attributes than those who do not to enrol to the MFI. The sample is therefore not random as many "potential" clients will not join and others with specific attributes may drop out (Coleman, 1999, 2006). Entrepreneurs who are more willing to take risk and face poor business outcomes exit the MFI. Theoretically, under a homogeneous distribution of performance among risk averse entrepreneurs, this survival bias would lead to a positive correlation between performance and risk taking. Given that we find a negative effect of risk taking on performance, it is unlikely that our sample is much influenced by a survival bias of this kind. It would also mean that we underestimate of the negative effect of risk taking on performance.

The two proposed views on the relationship between financial constraints, risk taking and firm performance, are opposing but not mutually exclusive. We show that the *positive effect of financial constraints* on reducing the adverse impact of risk taking on firm performance dominates, but we cannot say anything on the absolute size of this effect, only on the difference between the two effects. The *negative effect of financial constraints* of increasing the impact of a negative shock may still be present. Future research may disentangle the absolute size of these two effects for policy purposes.

Our study implies that expanding access to credit can have unintended consequences, as some entrepreneurs that are empowered by microfinance may not benefit from such funding. New loans leading to increased investment in potentially risky projects may not result in positive returns in a high risk environment. The provision of micro credit could be supplemented with microinsurance schemes that mitigate the high risks (Churchill & Roth, 2006) or be further supported by business educational programs (Karlan & Valdivia, 2011) which make business owners aware of risks (Berge, 2011). Financial constraints are not to be stimulated, but the risks faced by the entrepreneur should be mitigated.

Appendix 1

In order to better appreciate the living situation of the Tanzanian entrepreneurs we include a detailed overview of their household's asset wealth (see Table A1). This is important because the microenterprises are often inseparable from the household. We list summary measures of 27 wealth items and their respective (Varimax-rotated) factor loadings. The average household size is 3.3. Using principal components we force each of the 27 asset items into a single asset wealth factor, which explains 51% of the underlying variation in assets holdings. The internal reliability coefficient for the factor is 0.82 (corrected Cronbach's alpha, see Boermans & Kattenberg, 2011) and the Kaiser-Meyer-Olkin (KMO) measure the sampling adequacy is 0.80; both statistics suggest that the derived latent factor is reliable and consistent. Looking at the asset holdings in Table A1, the entrepreneurs cannot be classified as the poorest of the poor (see Sahn & Stifel, 2000). Also, since the survey was undertaken in the main metropolitan area of the country, we note that the entrepreneurs hold relatively few livestock.

Table A1: Asset wealth factor of the entrepreneur's household

Item	Median	Mean	S.d.	Min.	Max.	Loadings
Sewing machine	0	0.35	0.83	0	9	0.36
Cloth ironer	1	0.91	0.51	0	3	0.50
Table	1	1.55	0.88	0	6	0.53
Soda	1	1.46	1.28	0	10	0.48
Mosquito net	2	2.10	1.25	0	8	0.66
Paraffin lamp	1	1.22	0.91	0	6	0.22
Bed	2	2.28	1.30	1	8	0.69
Refrigerator/freezer	0	0.49	0.61	0	4	0.59
Electrics/gas/other stove	0	0.84	0.97	0	4	0.35
Radio/cassette	1	0.78	0.56	0	3	0.55
Video/dvd player	1	0.55	0.59	0	3	0.60
PC	0	0.08	0.30	0	2	0.43
Television	1	0.66	0.57	0	4	0.46
HiFi	0	0.04	0.21	0	2	0.28
Watch	1	0.76	0.78	0	5	0.56
Mobile/phone	2	1.84	0.88	0	7	0.59
Motorcycle	0	0.05	0.24	0	2	0.26
Bicycle	0	0.20	0.46	0	4	0.29
Car/truck	0	0.05	0.26	0	3	0.33
Wheelbarrow	0	0.05	0.22	0	2	0.25
Cart	0	0.06	0.27	0	2	0.21
Fan	1	0.83	0.86	0	6	0.67
Cattle	0	0.09	0.85	0	15	0.01
Goats	0	0.07	0.58	0	6	0.18
Sheep	0	0.04	0.57	0	10	0.03
Acres of land	0	0.77	3.56	0	50	0.03
Acres of land (12 months ago)	0	0.80	3.60	0	40	0.03

Appendix 2

In this Appendix we provide more information about matching procedure to show there are indeed ex ante differences in observable characteristics. That is, we show that in general, financially constrained entrepreneurs run smaller enterprises, have younger firms, are themselves younger, less-educated, and have a lower asset wealth (see also correlation matrix, Table 1). Most significantly, after matching these differences disappear, meaning that we evaluate the effect of financial constraints among microenterprises that have a comparable likelihood for being constrained.

In Table B1 the first stage probit estimates are presented for the matching procedures. For each specification, the F-values of the first stage regressions are above 10 (Rosenbaum & Rubin, 1983). To show that matching is relevant due to ex ante differences in entrepreneurs who are or are not financially constrained, in Table B2 Panel A we show that there are indeed important ex ante differences in the covariates. Table B2 Panel B further explains how after the first stage probit regressions such differences disappear with the matching procedures. Table B3 gives similar results for risk taking and risk averse entrepreneurs. Still, there may be unobservables that differ across the two groups, however, note that the entrepreneurs who are long-term clients at the MFI form a relatively homogeneous group in terms of entrepreneurial attitude.

Table B1: First stage probit regression results

Explanatory variables	Dependent variables used for matching				
	Loan cycle (FC)	**Savings (mean)**	**No savings**	**Risk averse**	**Risk taking**
Firm size	-0.030	0.089*	-0.122*	-0.0719	0.093**
	[0.039]	[0.048]	[0.074]	[0.053]	[0.044]
Months open	-0.036	0.022	-0.019	0.064	-0.073*
	[0.039]	[0.040]	[0.040]	[0.043]	[0.038]
Young firm	0.391***	0.020	-0.154	-0.188	0.093
	[0.145]	[0.144]	[0.144]	[0.142]	[0.142]
Male	0.157	0.141	0.0274	-0.026	0.256**
	[0.113]	[0.115]	[0.114]	[0.113]	[0.116]
Age	-0.057	0.065	-0.045	-0.003	-0.033
	[0.040]	[0.043]	[0.040]	[0.0395]	[0.0407]
Age^2	0.000	0.000	0.001	0.000	0.000
	[0.000]	[0.001]	[0.000]	[0.000]	[0.000]
Second educ.	-0.095	0.882***	-0.599**	-0.202	0.441**
	[0.218]	[0.226]	[0.253]	[0.224]	[0.214]
Asset wealth	-0.108*	0.199***	-0.0493	0.084	0.048
	[0.061]	[0.062]	[0.063]	[0.061]	[0.0628]
Constant	1.990	-2.057	0.853	-1.009	0.732
Wald χ^2	31.94***	44.18***	13.23*	10.75	18.57**
Pseudo R^2	0.041	0.061	0.025	0.015	0.027

Table B2: Mean differences (ex ante, ex post) in covariates for financial constraints

Panel A: Before matching

	loan cycle (FC)	no FC	t-value	sig	Savings (above mean)	Savings (below mean)	t-value	sig	No savings	Savings	t-value	sig
Firm size	0.63	0.8	-1.54		0.93	0.57	3.03	***	0.47	0.82	-2.93	***
Young firm	0.23	0.12	3.7	***	0.17	0.19	-0.88		0.17	0.19	-0.53	
Months open	11.51	11.65	-1.24		11.66	11.52	1.23		11.52	11.59	-0.59	
Male	0.36	0.31	1.5		0.36	0.33	0.87		0.35	0.33	0.35	
Age	36.83	39.4	-3.7	***	37.94	37.85	0.12		37.8	37.92	-0.16	
Sec. educ.	0.06	0.08	-0.58		0.14	0.03	5.15	***	0.03	0.09	-2.46	**
Asset wealth	-.11	0.16	-3.52	***	0.24	-0.13	4.82	***	-.10	0.05	-1.93	*

Panel B: After matching

	loan cycle (FC)	no FC	t-value	sig	Savings (above mean)	Savings (below mean)	t-value	sig	No savings	Savings	t-val.	sig
Firm size	0.63	0.66	-0.32		0.93	1.03	-0.59		0.47	0.53	-0.53	
Young firm	0.23	0.22	0.07		0.17	0.18	-0.38		0.17	0.21	-1.11	
Months open	11.51	11.57	-0.21		11.66	11.79	-1.3		11.52	11.38	0.89	
Male	0.36	0.39	-0.89		0.36	0.32	1.01		0.35	0.39	-1.01	
Age	36.83	37.19	-0.4		37.94	38.08	-0.17		37.8	38.38	-0.67	
Sec. educ.	0.06	0.07	-0.47		0.14	0.13	0.14		0.03	0.02	0.58	
Asset wealth	-.11	-0.11	0.18		0.24	0.29	-0.58		-.10	-0.12	0.3	

Table B3. Mean differences (ex ante, ex post) in covariates for risk attitudes

Panel A: Before matching

	Mean	**Mean**			**Mean**	**Mean**		
	Risk averse	Not risk averse	t-value	sig	Risk taking	Not risk taking	t-value	
Firm size	0.58	0.77	-1.58		0.92	0.61	2.52	***
Young firm	0.15	0.20	-1.66	*	0.20	0.18	0.63	
Months open	11.68	11.50	1.59		11.45	11.61	-1.41	
Male	0.33	0.34	-0.20		0.40	0.32	1.96	**
Age	38.52	37.50	1.42		37.78	37.92	-0.20	
Secondary education	0.06	0.07	-0.50		0.10	0.05	2.34	**
Asset wealth	0.07	0.04	1.46		0.72	-0.03	1.22	

Panel B: After matching

	Mean	**Mean**			**Mean**	**Mean**	
	Risk averse	Not risk averse	t-value	sig	Risk taking	Not risk taking	t-value
Firm size	0.58	0.67	-0.78		0.92	0.89	0.19
Young firm	0.15	0.12	-1.60		0.20	0.23	-0.77
Months open	11.68	11.78	-1.12		11.45	11.50	-0.34
Male	0.34	0.41	-1.64		0.40	0.38	0.32
Age	38.52	39.15	1.42		37.78	37.10	0.74
Secondary education	0.06	0.07	0.50		0.10	0.13	-0.81
Asset wealth	0.07	0.08	-0.12		0.72	-0.03	1.04

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