

Koch, Melanie; Menkhoff, Lukas

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## The non-linear impact of risk tolerance on entrepreneurial profit and business survival

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# 2067

## Discussion Papers

# The Non-linear Impact of Risk Tolerance on Entrepreneurial Profit and Business Survival

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DIW Berlin  
German Institute for Economic Research  
Mohrenstr. 58  
10117 Berlin

Tel. +49 (30) 897 89-0  
Fax +49 (30) 897 89-200  
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# The non-linear impact of risk tolerance on entrepreneurial profit and business survival\*

Melanie Koch<sup>†</sup>

Lukas Menkhoff<sup>‡</sup>

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## Abstract

Entrepreneurs tend to be risk tolerant but is more risk tolerance always better? In a sample of about 2,100 small businesses, we find an inverted U-shaped relation between risk tolerance and profitability. This relationship holds in a simple bilateral regression and also when we control for a large set of individual and business characteristics. Apparently, one major transmission goes from risk tolerance via investments to profits. This is quite robust as it applies for past investments as well as planned investments. Considering business survival, we show, first, that less profitable businesses leave the market while moderately risk tolerant entrepreneurs survive more often. Second, the high risk-low profit part of the U-shaped relation seems to disappear among businesses being four years and older, indicating that such inferior risk-profit combinations disappear over time. These findings are important for the concept of business readiness trainings as the motivation (and ability) to take risks should potentially be accompanied by some warning that too much risk taking can be detrimental to long-term business success.

**Keywords:** risk tolerance; entrepreneurs; profits; investments

**JEL:** D22; D81; L26; M21

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<sup>†</sup>Oesterreichische Nationalbank (OeNB), Vienna, Austria;

Email: [melanie.koch@oenb.at](mailto:melanie.koch@oenb.at)

<sup>‡</sup>Corresponding author. Humboldt-Universität zu Berlin, German Institute for Economic Research (DIW Berlin), and IfW Kiel, Germany;

Email: [lmengkhoff@diw.de](mailto:lmengkhoff@diw.de)

# 1 Introduction

Entrepreneurs leading small businesses have a strong impact on how their business operates. Personal characteristics of the owner and manager shape the course of the business. A core characteristic of interest is the individual risk tolerance of such entrepreneurs. It is often found that entrepreneurs have a higher risk tolerance than the average adult. Running a business is inherently riskier than being employed as it comes with more volatile returns, including the failure of operations (e.g., [Caliendo et al., 2009, 2014](#); [Kerr et al., 2019](#); [Chanda and Unel, 2021](#)). However, personality characteristics that motivate one to become an entrepreneur may be not necessarily the same that make one a successful entrepreneur ([Hamilton et al., 2019](#)).

In many economic models on decision-making, profit is maximized under risk neutral preferences but not under risk averse or risk seeking preferences. In particular, for decision making under risk, the risk neutral agent is the one who maximizes expected returns. Why should this be different for entrepreneurial decision making, where outcomes are inherently risky or even uncertain? Following this reasoning, we ask whether successful entrepreneurs are characterized by a moderate level of risk tolerance that is largely in line with risk neutrality. While there are studies suggesting related arguments (which we discuss below), our question about a potentially non-linear impact of risk tolerance on *profitability* seems to be neglected in existing empirical work.

We conduct a survey study with about 2,100 small entrepreneurs in Western Uganda comprising rich information about their business and personal characteristics. These small entrepreneurs operate in trading centers, i.e., groups of several enterprises of various kinds. All of them are retailers, service providers, or small manufacturers. Two-thirds of the entrepreneurs work alone in their business, i.e., have no regular employees. The others typically have between one and three employees. We measure risk tolerance using a self-assessment of each individual’s “willingness to take financial risk,” as introduced by [Dohmen et al. \(2011\)](#); a closely related measure has been experimentally validated by them. We also measure profits via self-assessment of the entrepreneurs, a procedure

whose usefulness is demonstrated for small enterprises in low-income countries by [De Mel et al. \(2009\)](#). As profits are intended to capture business success and not just business size, we prefer to control for size which is approximated by the number of workers. Thus, the respective main outcome measure is profit per worker.

We regress profit per worker and total profits on financial risk tolerance. Figure 1 illustrates our main result using a linear and a non-linear (quadratic) approach, respectively. Starting with the linear approach, the two grey regression lines trend clearly upwards, confirming the expectation that risk taking and profits go hand in hand. In particular, we are interested whether there is something like “too much risk tolerance,” i.e., that risk tolerance above a certain level may no longer be helpful in realizing higher profitability. Therefore, we also estimate the quadratic model. Indeed, the non-linear relations, plotted as black lines, initially increase with risk tolerance before declining for high risk tolerance.

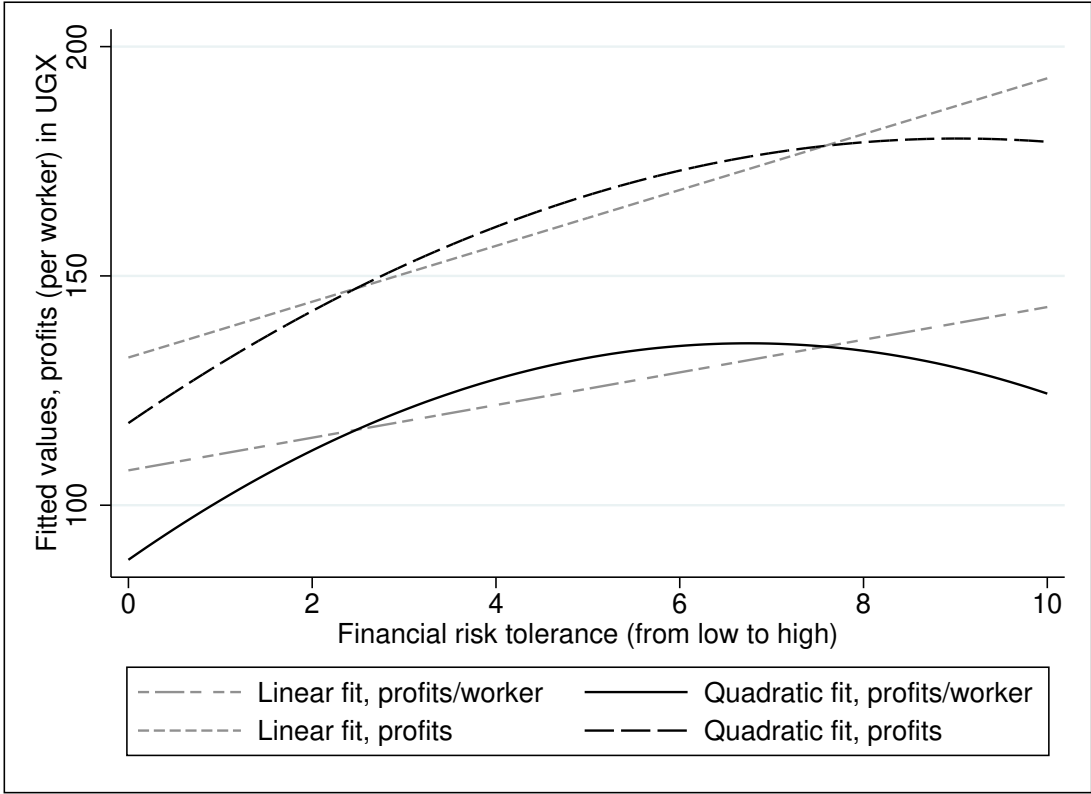


Figure 1: Regressing profits (per worker) on risk tolerance, linear and quadratic fit

Note: Fits are obtained via bivariate regressions. The turning points for the quadratic fits are at values 6.7 and 9 respectively. Multivariate linear regressions show a similar picture with turning points between 5.5-6.5 for the quadratic fits.

While Figure 1 shows the bivariate relation of interest, we further conduct a multivariate regression analysis in which we control for individual characteristics of the entrepreneurs and characteristics of their businesses. The consideration of these variables shows that many of them are reasonably related to the profitability of businesses, so that – for example – better educated entrepreneurs generate higher profits. Reassuringly, however, if considering them, they do not qualitatively change the significant and quadratic relationship between risk tolerance and profits.

An issue that can arise in such a regression analysis is the potential endogeneity of risk tolerance. Existing literature does not raise this concern often because individual preferences, such as risk tolerance, were regarded as invariant and exogenous. This has changed. Three influences seem to be systematic, i.e., age, past shocks, and current emotions (Schildberg-Hörisch, 2018). We do not observe emotions during the survey interview, which increases noise in the large cross-sectional regression, but we can control for age and past shocks, which confirms our results. Further, our results also hold when we analyze the risk-profitability relation of those small businesses that still operate more than one year after measuring risk tolerance.

We provide a possible channel of how risk tolerance leads to the non-linear profitability pattern we document. Motivated by previous literature, we look at investments as potential mediator. Indeed, the volume of investments during the preceding year has a strong influence on profitability while much reducing the influence of risk tolerance in both the linear and the quadratic terms. Thus, investments serve as a mediator variable. Surprisingly, (past and planned) investments themselves show the inverted U-shaped pattern in relation to the risk tolerance that we have seen for profitability. This may be interpreted as suggesting that risk averse entrepreneurs invest too little and that the most risk tolerant may underestimate the necessity of investments (and overestimate their success). In contrast, moderate levels of risk tolerance go along with the highest investments and then the highest profitability and profits.

Finally, we analyze small business survival by surveying a second time 18 to 24

months after compiling the baseline data. Surviving businesses differ from closed businesses mainly by their higher average profitability and higher investments at baseline (see [Manso, 2016](#)), in line with the consequence of conventional market forces. Interestingly, entrepreneurs still in business are slightly more risk tolerant at baseline. We confirm these patterns when “looking backwards,” i.e., by comparing businesses being in operation for a different length of time at baseline. Here, we find for businesses in operation for four years or longer that the tentatively inefficient combination of high risk tolerance and limited profitability seems to disappear; this would also indicate the working of market forces.

Results of this study cannot be automatically generalized as with other case studies dominating the literature. This holds, in particular, when comparing a poor rural area with high-income countries. However, studies such as ours compare entrepreneurs with different risk tolerance within a given institutional setting, so that for example hindrances due to limited financial development apply in principle to all entrepreneurs operating in rural Uganda. Thus, it may be reassuring that we find a very similar set of determinants explaining profits or survival as has been found in related studies before.

**Theoretical considerations.** In microeconomic models of the firm, optimal decision-making is typically derived under risk neutrality. This is because risk neutrality usually maximizes expected returns (not utility); for example, under expected utility theory. Risk neutrality translates into a real world where managers maximize firm owners’ value and firm owners, who bear the risk of these decisions, are well diversified. However, the case is different for entrepreneurs who hold much, if not most, of their wealth in their own business. Here, risky entrepreneurial decisions may affect personal consumption possibilities such that the degree of individual risk tolerance will impact business decisions. With personal consumption at stake, small-business owners might rather resort to less risky firm decisions. In this sense, risk averse decisions lead to lower investments in general ([Panousi and Papanikolaou, 2012](#)) or lower innovation-related investments ([Caggese, 2012](#)); consequently, lower growth and/or lower profitability follows.

Arguably, the concept of Knightian risk used in standard models might not be appro-



appropriate for real-life decision making. Under Knightian risk, objective outcome probabilities are always given. In entrepreneurial decision-making, this is rather unlikely; instead, outcome probabilities are uncertain. The point that research should focus more on the concept of uncertainty instead of risk when thinking about entrepreneurship was already made in [Knight \(1921\)](#). While acknowledging this fact, we still focus on risk in line with the literature on which our work is based. Moreover, the self-reported measure of risk is a compromise in this respect: even though economists differentiate between Knightian risk and Knightian uncertainty, this is not necessarily true for the general population or small entrepreneurs. When asking them how willing they are to take risks, they well might have uncertainty in mind instead of risk. We nevertheless continue to use the term risk throughout the paper.

While the positive relation between risk tolerance and business success is well established, there is less evidence about an effect of highly risk tolerant, i.e., risk seeking, entrepreneurs on business success. The theoretical response may be the analogy to risk averse entrepreneurs, implying that risk seeking provides utility that compensates for lower returns. Thus, the resulting outcomes may be due to a fully rational decision, as modeled for some entrepreneurs in [Vereshchagina and Hopenhayn \(2009\)](#). This impact of risk-seeking may be similar in its consequences to overconfidence, which has a long-standing tradition in entrepreneurship research (e.g., [Moskowitz and Vissing-Jørgensen, 2002](#)). Overconfidence can lead to too much optimism about business outcomes, tending to reduce business success ([Koellinger et al., 2007](#)). With respect to investment behavior, over- (under)confidence is shown to be related to over- (under)investment (e.g., [Malmendier and Tate, 2005](#); [Pikulina et al., 2017](#)).

In summary, theoretical considerations about entrepreneurial decision making show that risk neutral decision makers may realize the highest degree of business success, i.e., here measured via profitability. By contrast, an increasing level of risk aversion will lead to less investments and less business success. Toward the other extreme of risk tolerance, i.e., risk seeking behavior, theory indicates that this will not be compensated by higher returns.

In total, these patterns suggest an inverse U-shaped relation between risk tolerance and profitability that is mediated by investment behavior.

**Literature.** Our study contributes to the literature examining the role of risk tolerance on entrepreneurial behavior. The decision to run a business, even a very small one, requires some degree of risk tolerance, also in low-income countries (e.g., [Willebrands et al., 2012](#); [Sharma and Tarp, 2018](#)). While this is intensively studied, there is much less empirical work on the potentially non-linear relation of risk tolerance to measures of business success ([Kritikos, 2022](#)). An early study by [Begley and Boyd \(1987\)](#) covering 147 entrepreneurs (and 92 other CEOs) finds that, among entrepreneurs, risk aversion is related to return on assets in the form of an inverted U-shape. [Caliendo et al. \(2010\)](#), analyzing the fact of remaining self-employed in a large representative sample of the German population, the German Socio-Economic Panel (SOEP), find a U-shaped relation between risk tolerance and exit from being self-employed, i.e., an inverted U-shape for remaining in the market. [Nieß and Biemann \(2014\)](#) extend and confirm the [Caliendo et al. \(2010\)](#) study by considering further waves of the SOEP-data. Only the study by [Kreiser et al. \(2013\)](#), analyzing a heterogeneous sample of 1,600 firms from ten countries, finds that moderate risk aversion comes with low sales growth. Further studies do not apply an explicit non-linear approach but conclude that a moderate degree of risk tolerance may facilitate success; these include [Hvide and Panos \(2014\)](#) on Norway and [Willebrands et al. \(2012\)](#) for Nigerian small entrepreneurs' revenues.

While these studies tend to support an inverted U-shaped relation between risk tolerance and return on assets or survival, respectively, they do not consider profitability, which seems to be a core criterion of success. Moreover, these earlier studies do not always analyze a transmission mechanism through which risk tolerance may impact business success. Finally, we analyze entrepreneurs over time and find market forces at work: those exiting the market are primarily characterized by lower profitability and low risk tolerance, those surviving are more similar over time in their profitability.

From a methodological perspective, revealing an impact of risk tolerance on profitabil-

ity requires controlling for individual and business characteristics (or a quasi-experiment as in [De Blasio et al., 2021](#)). In particular, these controls include the age and education of the entrepreneur and the age of the business (see, e.g., [McKenzie and Woodruff, 2017](#); [Bernstein et al., 2022](#)). Further, as risk tolerance depends on systematic influences, these should be considered. [Schildberg-Hörisch \(2018\)](#) states a pattern over the life-cycle (e.g., [Dohmen et al., 2017](#)), an impact of shocks in life (e.g., [Malmendier and Nagel, 2011](#)), and a temporary impact from all kinds of emotions ([Meier, 2022](#)). Unlike most other studies, we can control for age and shocks (albeit imperfectly). Regarding emotions, there are no survey items available, so that we have to accept the resulting “noise,” from which we do not expect a systematic influence on the risk-profit-relation.

Putting the case of a potentially non-linear effect of risk tolerance on profits into a broader perspective, there are other studies discussing related issues. [Puri and Robinson \(2007\)](#), for example, find that some degree of optimism is useful for firm success but that a very high degree of optimism leads to suboptimal results. [De Meza et al. \(2019\)](#) show that more optimistic small entrepreneurs earn less, where optimism is measured before the entry decision. [Malmendier and Tate \(2015\)](#) review findings on the impact of overconfidence on managers’ behavior and outcomes; as the word overconfidence indicates, its impact is tentatively negative, while confidence is definitely important for running a firm. This distinction between the starting and running phase of new businesses is also found in the meta-analysis of [Kraft et al. \(2022\)](#). Interestingly, there may be a few instances, such as implementing innovations, where some degree of overconfidence can even be helpful. Overall, optimism, confidence, and risk tolerance of entrepreneurs or top managers facilitate business success but there can be too much of a good thing.

The paper is structured in five sections. Section 2 describes the setting of the study, the data, and the methodology. In Section 3, we present the main results and discuss potential transmission channels and business survival. Section 4 provides robustness checks while Section 5 concludes.

## 2 Setting, data, and methods

### 2.1 Setting of our study

The data of this research stem from a study in Western Uganda, where a financial education treatment was tested. For our study, we mostly use the baseline data that were collected in Spring 2019, i.e., before the treatment. When we conduct regressions on business survival using the second survey wave, which was carried out between October 2020 and April 2021, we control (as robustness check) for the financial education intervention that took place in Summer 2019 for the treatment group, but not for the control group.

The study conducted a survey of small businesses in all trading centers in the rural Bunyangabu and Kabarole districts of Western Uganda. These districts are typical for many rural areas in low-income countries, as they are characterized by a high share of agricultural activities and a lack of functioning infrastructure. Small businesses in this area cluster in villages where people live (or pass through via traffic) to provide a minimal customer base. The accumulation of a few or many businesses forms a trading center. These small businesses cover three sectors, i.e., retailing, manufacturing, and services. Data collection considers all businesses from the small and medium sized trading centers. However, it under-samples the seven large centers with more than 100 shops, where every third shop is visited randomly due to resource constraints. Overall, the survey team identified about 5,500 small businesses in 108 trading centers, of which 2,223 were interviewed (for a map see Appendix Figure A1). The remaining businesses were either not open when the team visited or were left out in the big centers by design.

### 2.2 Data

The data we collect inform about the entrepreneurs, i.e., the business owners, their small firms, and the last big adverse shock that these entrepreneurs faced. Our key individual characteristic of interest is financial risk tolerance, as measured by responses to a standard scale of willingness to take risk related to investing and borrowing, ranging between 0-

completely unwilling and 10-fully prepared (see [Dohmen et al., 2011](#)). This measure has been widely applied in the literature, not just because it can be easily implemented in surveys but also because it has been validated by experimentally derived measures of risk tolerance. Moreover, its power in predicting field behavior is rather better than worse compared to experimental measures, at least in developing countries ([Menkhoff and Sakha, 2017](#)). For robustness purposes, we also consider the analogous response to willingness to take risk in general. Further characteristics that may influence entrepreneurship or risk taking are gender (women operate businesses less often), age (younger individuals are more risk tolerant), education (better educated are more risk tolerant), financial literacy as a specific qualification to run a firm, the individual work experience (as an aspect of human capital), and the ability to borrow a larger amount indicating access to credit and/or the ability to bear risk (more details are provided in Appendix Table [A1](#)).

Regarding adverse idiosyncratic shocks, we use information about the estimated costs of the last unexpected emergency. Taking the amount into the regressions ensures that only severe shocks are considered. In Section 4 on robustness, we further consider the shock amount relative to the consumption level in order to gain a sense about its relative impact and other variables that are related to shocks.

The key firm characteristic for our research is profits of the small business, the number of workers who are regularly working at the business, and the resulting *profits per worker*. The respective survey item is an outright question about profits in the last four weeks, which is shown to be reliable and easy to compile vis-à-vis alternatives (see [De Mel et al., 2009](#)). Further variables of interest include business age, as older firms are less risky (here approximated by the years the entrepreneur is working in the specific business), and the sector of business (distinguishing between retail, service, and manufacturing). Finally, we consider investments by the respective small business. Here, the information is about the investment amount during the last 12 months prior to the survey.

We note that there are missing values in the following variables: age (0.4% of all observations), profits (1.9%), investments (1.4%), and months the shop was open (0.1%

of all observations; this variable is used in the robustness analysis). Considering only complete cases results in an estimation sample of 2,144 observations. The 79 incomplete cases differ from the remaining estimation sample in some characteristics but, overall, differences do not seem to be economically crucial (see Appendix Table A2). Moreover, information between work experience and the age of the business is inconsistent in 53 out of the original 2,223 observations: respondents said that they have worked longer in that recent shop than they reported to have worked in any shop, considering their whole experience. However, the differences are mostly smaller than one year and might be due to mistakes in memory. In these cases, we set the work experience equal to the age of the business.

The descriptive statistics in Table 1 show that the sample population is 64% female, about 34 years old, the median has primary education, and, on average, has about seven years of experience working in a shop.

Table 1: Descriptive statistics

	Mean	Median	Std. Dev.	Min.	Max.
Profits last month (in 1000 UGX)	162.28	100.00	218.80	0.00	1500.00
No. of workers	1.43	1.00	0.70	1.00	12.00
Profits per worker (in 1000 UGX)	125.19	70.00	176.90	0.00	1500.00
Financial risk tolerance	4.94	5.00	2.55	0.00	10.00
Female	0.64	1.00	0.48	0.00	1.00
Age (in years)	33.69	30.00	11.42	16.00	82.00
Education level (0-5)	1.46	1.00	1.37	0.00	5.00
Financial literacy (std.)	0.01	0.22	1.00	-2.21	2.05
Work experience (in months)	82.51	55.50	90.91	0.00	660.00
Able to borrow 100,000 UGX (share)	0.86	1.00	0.35	0.00	1.00
Financial shock cost (in 1000 UGX)	134.98	5.00	386.21	0.00	3000.00
Age of business (in months)	54.38	36.00	69.27	0.00	612.00
Sector: retail (share)	0.69	1.00	0.46	0.00	1.00
Sector: services (share)	0.26	0.00	0.44	0.00	1.00
Sector: manufacturing (share)	0.04	0.00	0.21	0.00	1.00
Investments last 12 months (in 1000 UGX)	1422.75	500.00	2776.70	0.00	20000.00

*Financial risk tolerance* is measured on a scale from zero to ten, *education level* is measured from 0 (no education or incomplete primary) to 5 (university). All variables measured in UGX are winsorized at the value 0 and at 99%. *Financial literacy* is a standardized score based on seven knowledge questions.

About 86% are able to borrow 100,000 UGX (ca. 27\$), which is about half of the median monthly, equivalized household consumption. Most businesses operate in the retail sector (69%), with 26% in the service sector and only a small fraction in manufacturing. On average, the shops are less than five years old, with the median shop existing for only three years, so far. The median amount invested in the last 12 months is five times the median profit yielded in the last four weeks, indicating that these are primarily gross investments, such as shop inventories.

As we are particularly interested in risk tolerance and profitability, we show the distribution for these variables in Figure 2. The left panel shows a conventional histogram of the self-reported willingness to take financial risk on a scale between 0 and 10 with a peak at and around 5, i.e., the middle categories, and some smaller peaks at the extremes of the distribution. This measure of risk tolerance needs to be transformed into the three common areas of risk preferences, i.e., averse, neutral, and seeking. [Dohmen et al. \(2011\)](#) show the distributions of the self-reported scale and an incentivized experimental risk measure for the identical population in Germany. Using the experimental measure, they find that about 78% are risk averse, 13% risk neutral, and 9% risk seeking, but they do not show the scale responses of those who are risk-neutral in the experiment. They refer to an almost identical distribution for the U.S. Applying this to our case, the respective answering categories reproducing the same distribution would be quite exactly 1 to 6 for risk averse, 7/8 for risk neutral, and 9/10 for risk seeking. However, as poorer countries have higher levels of risk tolerance ([l'Haridon and Vieider, 2019](#)), we prefer to enlarge the range of risk-seeking to category 8, implying that categories 8 to 10 indicate risk seeking behavior, and 6/7 indicate risk neutrality. Then, it follows from this procedure that about two-thirds of our population are regarded to be risk averse, 20% are risk neutral, and 15% risk seeking.

The right panel of Figure 2 provides the Kernel density estimate of profits per worker and overall profits. We winsorize all variables measured in UGX at the value zero from below and at the 99 percentiles from above to reduce the impact of outliers. The maximum

values for both absolute profits and profits per worker are then 1,500,000 UGX, while the mean and median profit per worker is clearly smaller than the mean and median absolute profit, respectively.

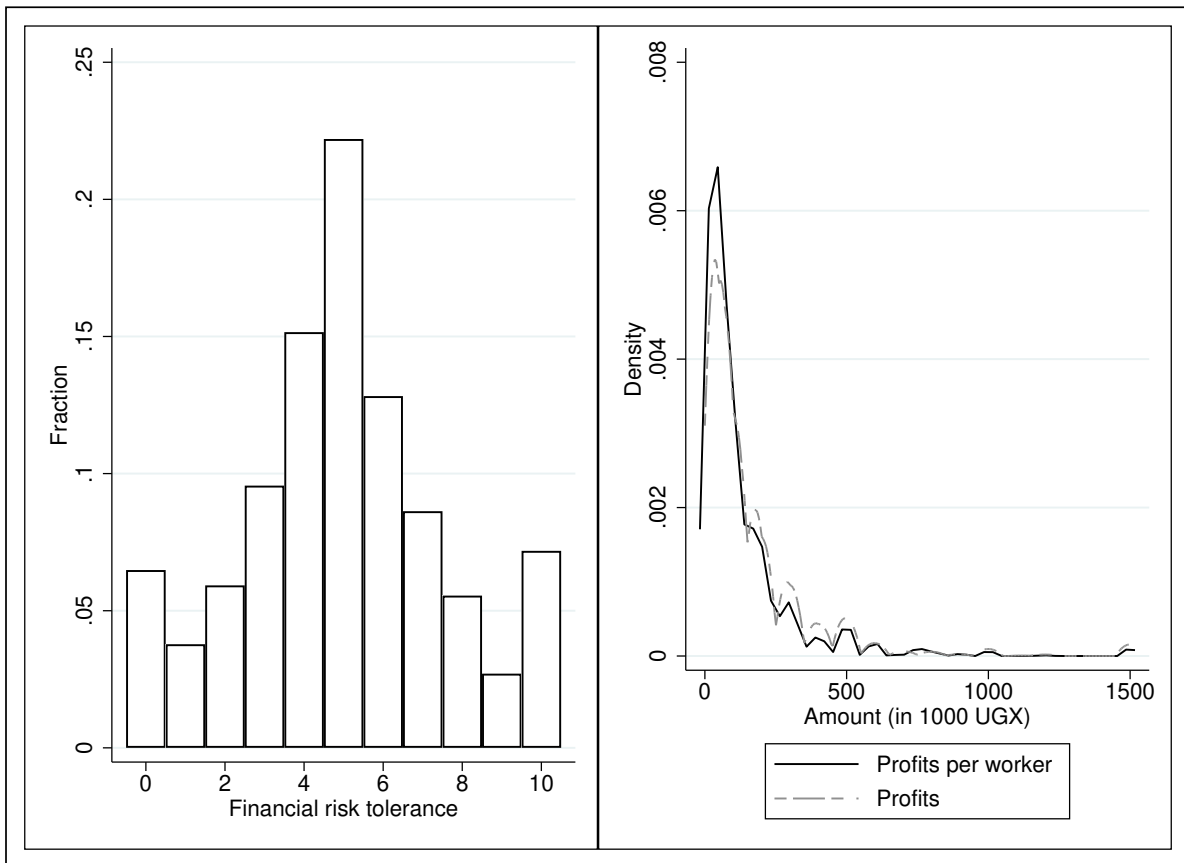


Figure 2: Histogram for the willingness to take financial risk from 0 to 10 (left) and kernel density estimate for (winsorized) profits per worker and absolute profits (right)

### 2.3 Empirical approach

We relate small entrepreneurs' risk taking and profitability to each other. Following the main literature, risk taking can be assumed to be exogenous under three conditions (Schildberg-Hörisch, 2018): one should control for age, shocks, and emotions. We include the first two control variables, while emotions at the time of the interviews remain unobserved and, thus, contribute to noise in the relation. While we cannot exclude that emotions may create a bias on our relations of interest, or that other unobserved characteristics may impact these relations, we note that our data provide a rich set of controls.



Thus, we interpret the relation – in line with the literature – as a tentatively causal impact of risk taking on profitability (keeping in mind the limitations of our identification). In this respect, in the robustness section, we also show that risk taking has qualitatively the same effect on the profitability of surviving businesses. Regarding a proper identification of the profitability of the small businesses, we use controls for characteristics of the entrepreneur, the business, and the industry. In sum, for the multivariate analysis in the next section, we use standard Ordinary Least Squares (OLS) regressions. The regressions take the following form:

$$Y = \alpha + \beta_0 R + \beta_1 RSQ + \sum_{j=2}^P \beta_j X_j + \epsilon \quad (1)$$

where  $Y$  is either absolute profits or profits per worker,  $R$  is financial risk tolerance,  $RSQ$  is financial risk tolerance squared, and  $X_j$  are the control variables. Standard errors  $\epsilon$  are clustered at the trading center level (108 clusters).

To address the heavily skewed values of profits and the other variables measured in UGX, we winsorize these as previously noted. Winsorizing at 99% already reduces the skewness tremendously. We use the winsorized variables throughout Section 3. In general, we do not apply log-transformation because, on top of some entrepreneurs reporting negative profits (5 observations), some reported zero profits (90 observations). These observations cannot be kept after the log-transformation without assumptions. Furthermore, we do not opt for selection models as the share of zeros is still overall small (less than 5%). Alternatively, in the robustness section, we apply the inverse hyperbolic sine transformation to all variables measured in UGX, which strongly accounts for skewness.

## 3 Results

### 3.1 Main results

While we show in the introduction the bivariate relation between financial risk tolerance and profits per worker, we now estimate this relation using the control variables as introduced in Section 2.2. Results in Table 2, columns (1) to (3) show effects on profits per worker and columns (4) to (6) on absolute profits. Column (1) shows the non-linear relation between risk tolerance and profits per worker as already depicted in Figure 1; profits increase up to a moderate level of risk tolerance of about 6.7; i.e., a level being close to risk neutrality. Subsequently there is indeed a turning point and risk tolerance is thereafter related to decreasing profits; this non-linearity can also be seen when capturing risk tolerance by dummy variables, i.e. not prescribing a functional form, as we show in the robustness section below. While, on average, the jump from risk level 0 to 1 increases profits per worker by around 12,000 UGX (i.e., about 0.05 standard deviation units), the jump from level 5 to level 6 increases profits by only about 1,500 UGX. The jump from level 6 to 7 then decreases profits per worker by 600 UGX.

In column (2), we add the full set of control variables, except investments, which are expected to be a mediator variable, and those intended for robustness checks. The coefficients of the two risk variables remain almost unchanged and significant, even though many of the control variables are typically related to risk tolerance. The coefficients of the other variables have the expected signs and are mostly statistically significant: entrepreneurs have higher profits if they are male, younger (but not too young), and better educated. However, the age effect is partially compensated by work experience and – more importantly – by the age of business (which is highly correlated with work experience; see [Azoulay et al., 2020](#)). Older businesses tend to be more profitable, while – in this sample – firms in manufacturing and the service sector are less profitable than those in the retail sector. Profits and ability to borrow are also positively related.

The main relations explaining profits per worker also hold in explaining absolute profits

as shown in columns (4) and (5). The results in columns (3) and (6) are discussed next.

Table 2: Profits per worker and profits – financial risk tolerance (scale from 0 to 10)

	Profits per worker			Profits		
	(1) Bivariate	(2) Controls	(3) Mediator	(4) Bivariate	(5) Controls	(6) Mediator
Financial risk tolerance	13.99*** (3.72)	10.91*** (3.48)	5.15 (3.62)	13.74** (5.42)	9.85* (5.31)	1.07 (5.35)
Financial risk squared	-1.04** (0.42)	-1.00** (0.39)	-0.48 (0.40)	-0.76 (0.59)	-0.76 (0.55)	0.03 (0.57)
Female		-51.91*** (8.07)	-44.01*** (7.10)		-79.37*** (9.96)	-67.97*** (8.84)
Age (in years)		2.94* (1.63)	1.01 (1.63)		3.79* (1.97)	1.01 (1.85)
Age squared		-0.04** (0.02)	-0.02 (0.02)		-0.06*** (0.02)	-0.03 (0.02)
Education level (0-5)=1		13.15** (6.29)	5.14 (6.31)		14.88* (7.71)	2.90 (7.81)
Education level (0-5)=2		39.08*** (11.22)	27.36** (10.98)		42.91*** (11.70)	26.58** (11.02)
Education level (0-5)=3		76.29*** (24.57)	66.01*** (22.94)		82.40*** (26.77)	68.05*** (24.69)
Education level (0-5)=4		61.80*** (18.35)	39.23** (17.77)		100.24*** (22.95)	67.82*** (21.17)
Education level (0-5)=5		148.50** (58.44)	113.86** (53.14)		193.88*** (64.41)	143.66** (56.05)
Financial literacy (std.)		10.80*** (4.10)	7.46* (3.97)		14.08*** (4.54)	8.93** (4.39)
Work experience (in months)		0.08 (0.06)	0.05 (0.06)		0.15** (0.07)	0.12 (0.08)
Able to borrow 100,000 UGX (share)		19.37** (8.31)	13.36 (8.23)		25.34** (11.20)	16.34 (10.93)
Financial shock cost (in 1000 UGX)		0.00 (0.01)	0.00 (0.01)		0.01 (0.02)	0.01 (0.02)
Age of business (in months)		0.23** (0.09)	0.26*** (0.10)		0.30*** (0.11)	0.34*** (0.11)
Sector: services		-21.38*** (6.26)	-11.35* (5.89)		-26.66*** (8.24)	-10.87 (7.17)
Sector: manufacturing		-41.24** (16.27)	-31.59** (14.39)		-51.33*** (18.72)	-37.76** (15.89)
Investments next 12 months (in 1000 UGX)			0.02*** (0.00)			0.03*** (0.00)
Constant	88.10*** (7.41)	33.67 (33.30)	66.23** (32.88)	117.91*** (12.01)	61.31 (41.78)	108.15*** (39.85)
Adj. R-Squared	0.004	0.086	0.137	0.005	0.113	0.187
Observations	2144	2144	2133	2144	2144	2133

Dependent variables: *profits* is winsorized at the value zero and at 99%, *profits per worker* is *profits* divided by the number of persons working regularly in the shop. Independent variables: *education level* is measured from 0 (no education or incomplete primary) to 5 (university) and *financial literacy* is a standardized score based on seven knowledge questions. All variables measured in UGX are winsorized at the value 0 and at 99%. Omitted category for *sector* is retail. Standard errors clustered at trading center level (108 clusters).

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

### 3.2 On the transmission channel

While a non-linear impact of risk tolerance on business profits seems plausible, here we examine our expected main channel by which the willingness to take risk is transformed into business success. As previously noted, risk aversion might lead to underinvestment. Because investments are risky, more risk tolerance will motivate greater investment and this should support business development. However, if risk tolerance increases further, there could be too much investment, similar to the case of overconfidence and overinvestment. Thus, we add investment to the set of explanatory variables of profits and hypothesize that investments serve as mediator between risk tolerance and profitability. The consideration of this additional variable is expected to increase explanatory power overall but to diminish the explanatory power of risk tolerance as risk tolerance is a main driver of investing. We emphasize that the consideration of investments should not be seen as a conventional control variable because investments are (partially) determined by risk tolerance and, thus, an outcome such as profits. Instead, their consideration provides a simple form of mediation analysis (see [Baron and Kenny, 1986](#)). Surprisingly, investments show the same non-linear relation to risk tolerance as that shown in Figure 1 above (see Appendix Figure A2). Thus, risk seeking does not seem to foster too much investment but again too few.

Results for the outcome variable *profits per worker*, where investments are added, are provided in column (3) in Table 2 and confirm expectations. The adjusted R-squared of the regression increases by about 90% and the coefficients of risk tolerance become smaller by more than a third, turning them marginally significant and insignificant, respectively. When explaining absolute profits in column (6), both risk variables also become much smaller and turn insignificant.

Further major changes in coefficients refer to the smaller coefficients of services and manufacturing sectors, indicating that the reference sector, i.e., retail business, gets many investments. This may seem somewhat surprising; it mainly refers to the stock of goods, as larger and broader supply makes the business more attractive and reduces cases of

non-availability of goods. Another major change is the decreasing coefficient of financial literacy. This indicates that the more financially literate also invest more and, thus, operate more profitably. It seems reasonable that the capabilities coming with financial literacy are related to more investments, while causality may go in both directions. Finally, the coefficient on ability to borrow decreases by almost a third and significance gets lost, indicating that borrowing ability supports investments.

Overall, investments seem to be determined by risk tolerance in a non-linear way and including them in the regression of profits on risk tolerance shrinks the coefficients on risk. Thus, investments serve as mediator for the final impact of risk tolerance on profitability.

### 3.3 Results looking forward

So far, we have analyzed the cross-section of small businesses. The non-linear impact of risk tolerance raises the question whether this has an influence on the survival of businesses. Is there evidence that those with lower profits will leave the market with higher probability?

We extend information beyond the cross-section used in Section 3.1 and make use of a follow-up survey wave. This wave contains, however, much fewer survey items, as it was mainly conducted via telephone due to the COVID-19 pandemic. In particular, the measures of risk tolerance and profits have not been surveyed again. Still, we know whether the same small businesses remained in operation.<sup>1</sup> This pandemic caused the most severe economic crisis in Uganda since 1985, as GDP fell by 1.5% while trend growth is in the range between 4% to 6% p.a. (with population growth above 3% p.a.). As the second wave was conducted after the pandemic had already hit economic activities, many businesses were closed permanently; at the same time, the pandemic and the following economic downturn limited the ability to open up new businesses.

From the considered sample of 2,144 entrepreneurs at baseline, 1,904 participated in

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<sup>1</sup> Around 82% of the people who were interviewed in the follow-up were contacted by phone in fall 2020. The other 18% were visited in spring 2021. Average profits at baseline do not differ significantly for business survivors interviewed in 2020 and survivors interviewed in 2021. The analogue holds true for those whose businesses did not survive.

the endline survey. Of these, 169 respondents report that they no longer operate their old business.<sup>2</sup> For 171 more entrepreneurs, who did not participate in the endline survey, we know that they have relocated. In addition to the 169, we also treat their businesses as closed.<sup>3</sup> This gives us a total of 2,075 “observed” businesses at endline, 340 of which were closed, i.e., about 16% of the total still observed (McCaig and Pavcnik, 2021, report in Vietnam 14-18% exit p.a.). Table 3 describes the three samples (with characteristics at baseline), i.e., (i) all 2,075 entrepreneurs and their businesses still observed at endline, and we distinguish these using the follow-up between (ii) business still open at follow up and (iii) business closed at follow up. There are many significant differences at baseline between open and closed businesses as Table 3 shows, indicating that the decision to close is determined by systematic factors.

Most important among these are profitability and investments: still open businesses had 37% higher profits per worker than closed ones and 47% higher investments. The other, mostly significant, differences also point in the expected direction but not as strongly: “surviving” entrepreneurs are more often male, older, have higher financial literacy, have longer work experience, and their businesses are older. Overall, qualified entrepreneurs and solid businesses survive more often, according to our data. For our purpose, the variable on risk tolerance is most interesting. This is somewhat higher for the operating vs closing entrepreneurs but the mean difference is not significant.

Thus, we plot the relation of interest between risk tolerance and profitability. Is it different for entrepreneurs of surviving vs closed businesses? Figure 3 shows results at baseline for the two groups (and for both groups together, for comparison). The main difference is, as expected from Table 3, that operating businesses show higher profitability than closed ones, suggesting that market forces drive out the less successful businesses. Moreover, there remains the quadratic relationship between risk and profits for survivors.

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<sup>2</sup> This sample divides into two groups, 86 persons no longer run a business and 83 opened a new business.

<sup>3</sup> In total, we could verify the whereabouts of 2,177 entrepreneurs. For the other 46, any kind of information is missing. For 202 out of the 2,177, there is no further survey information as these persons either relocated, were impaired, imprisoned, or deceased. We exclude all these 202 except those who relocated for obvious reasons.

Table 3: Descriptive statistics for business survival

	Observed endline (1)	Still open (2)	Closed (3)	Difference (3)-(2) (4)
Profits per worker (in 1000 UGX)	125.42 (177.7)	131.14 (184.2)	95.62 (135.0)	-35.52***
Financial risk tolerance	4.95 (2.550)	4.98 (2.545)	4.78 (2.576)	-0.21
Female	0.64 (0.480)	0.63 (0.483)	0.69 (0.461)	0.06**
Age (in years)	33.68 (11.34)	34.21 (11.43)	30.91 (10.49)	-3.29***
Education level (0-5)	1.46 (1.371)	1.48 (1.373)	1.40 (1.362)	-0.08
Financial literacy (std.)	0.01 (0.994)	0.04 (0.994)	-0.11 (0.984)	-0.15**
Work experience (in months)	82.57 (90.87)	84.47 (89.81)	72.65 (95.69)	-11.82**
Able to borrow 100,000 UGX (share)	0.86 (0.343)	0.87 (0.334)	0.82 (0.387)	-0.06**
Financial shock cost (in 1000 UGX)	135.24 (389.2)	143.60 (404.2)	91.70 (295.4)	-51.89***
Age of business (in months)	54.77 (69.48)	57.64 (71.21)	39.77 (57.42)	-17.87***
Sector: retail (share)	0.69 (0.463)	0.69 (0.462)	0.68 (0.467)	-0.01
Sector: services (share)	0.26 (0.441)	0.26 (0.439)	0.29 (0.455)	0.03
Sector: manufacturing (share)	0.05 (0.208)	0.05 (0.214)	0.03 (0.171)	-0.02*
Investments last 12 months (in 1000 UGX)	1433.60 (2795.5)	1511.36 (2932.7)	1028.27 (1880.6)	-483.09***
Share of borrowers	0.14 (0.343)	0.14 (0.344)	0.13 (0.339)	-0.00
Amount of Loan (in 1000 UGX)	57.87 (502.9)	62.36 (544.4)	34.46 (160.9)	-27.90*
Observations	2075	1741	334	2075

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ ; p-values are obtained using twosided t-tests.

*Profits per worker* is winsorized *profits* divided by the number of persons working regularly in the shop. *Observed endline* are all entrepreneurs interviewed at baseline for which we have business information at endline, *still open* are those who are still in business 15 months later and *closed* are those who do not own a shop anymore, who opened another shop or who relocated. *Financial risk tolerance* is measured on a scale from zero to ten. *Education level* is measured from 0 (no education or incomplete primary) to 5 (university). All variables measured in UGX are winsorized at the value 0 and at 99%. *Financial literacy* is a standardized score based on seven knowledge questions. Standard deviations in parentheses.

Interestingly, those who eventually closed their businesses have lower profitability at low and moderate levels of risk tolerance, but not at high levels. The latter may indicate that highly risk tolerant entrepreneurs left their businesses more vulnerable to the heavy crisis of 2020 so that even relatively profitable businesses had to close.

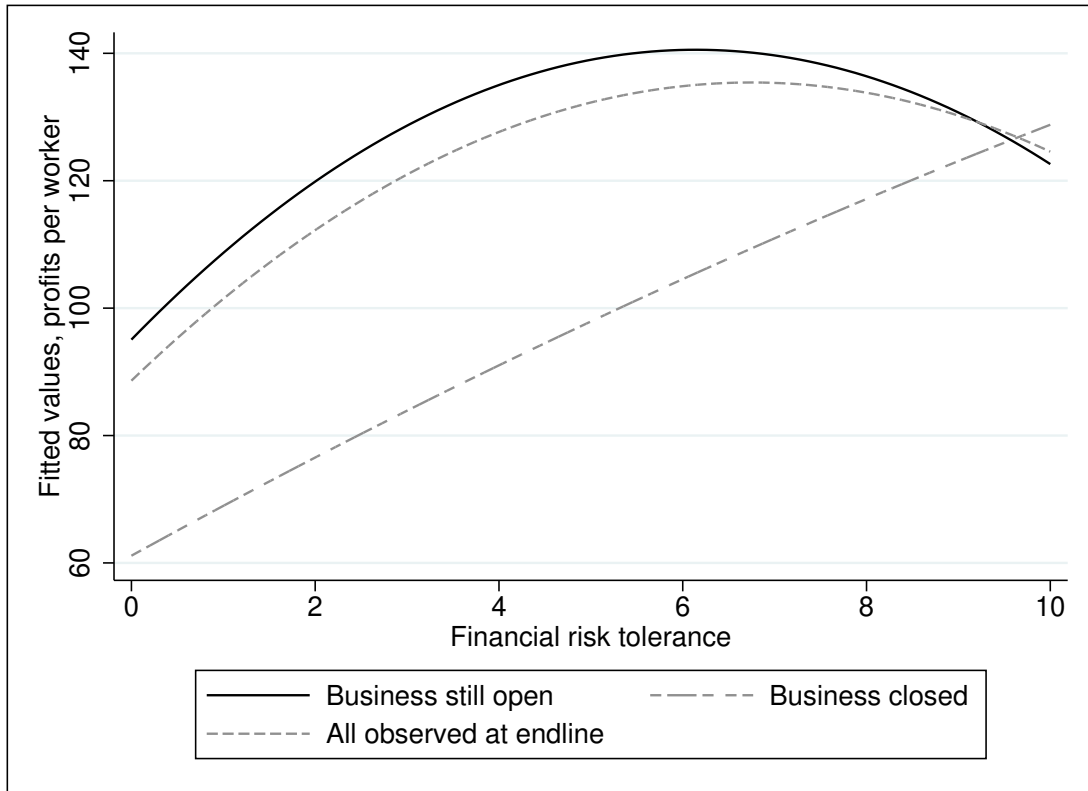


Figure 3: Regressing profits per worker on risk tolerance, survivors vs non-survivors

Results so far indicate that risk tolerance is important for business survival, and this relation seems to be non-linear. We test this by running a linear probability regression with our standard set of control variables to explain survival (a Logit model approach provides qualitatively the same results). As the quadratic non-linear relation may be not that clearly given in the data, we additionally use three levels of risk tolerance as introduced in Section 2.2, where the survey responses 6 and 7 are regarded as medium risk tolerant (or: risk neutral). Results in Table 4, columns (1) and (2) show that the quadratic relation between risk tolerance and survival is indeed difficult to see, but columns (3) and (4) are helpful in this respect as they show that a medium risk tolerance goes along with highest probability to survive, confirming [Caliendo et al. \(2010\)](#).



Table 4: Business survival, regressions

	Fin. risk tolerance		Fin. risk tolerance groups	
	(1)	(2)	(3)	(4)
	No mediator	Mediator	No mediator	Mediator
Financial risk tolerance	0.00	0.00		
	(0.01)	(0.01)		
Financial risk squared	0.00	0.00		
	(0.00)	(0.00)		
Fin. tolerance, level 6-7			0.06***	0.06***
			(0.02)	(0.02)
Fin. tolerance, level 8-10			0.01	0.01
			(0.03)	(0.03)
Female	-0.03**	-0.03*	-0.03**	-0.03**
	(0.02)	(0.02)	(0.02)	(0.02)
Age (in years)	0.02***	0.02***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Age squared	-0.00***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Education level (0-5)=1	0.02	0.02	0.02	0.02
	(0.02)	(0.02)	(0.02)	(0.02)
Education level (0-5)=2	0.04**	0.04*	0.04**	0.04*
	(0.02)	(0.02)	(0.02)	(0.02)
Education level (0-5)=3	0.03	0.03	0.03	0.02
	(0.04)	(0.04)	(0.04)	(0.04)
Education level (0-5)=4	0.06**	0.05*	0.06**	0.06*
	(0.03)	(0.03)	(0.03)	(0.03)
Education level (0-5)=5	-0.02	-0.02	-0.01	-0.02
	(0.05)	(0.05)	(0.05)	(0.05)
Financial literacy (std.)	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Work experience (in months)	-0.00***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Able to borrow 100,000 UGX (share)	0.04*	0.04*	0.04*	0.04*
	(0.02)	(0.02)	(0.02)	(0.02)
Financial shock cost (in 1000 UGX)	0.00**	0.00**	0.00**	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)
Age of business (in months)	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Sector: services	0.00	0.00	0.00	0.01
	(0.02)	(0.02)	(0.02)	(0.02)
Sector: manufacturing	0.04	0.05	0.04	0.05*
	(0.03)	(0.03)	(0.03)	(0.03)
Investments last 12 months (in 1000 UGX)		0.00**		0.00**
		(0.00)		(0.00)
Constant	0.43***	0.43***	0.43***	0.43***
	(0.08)	(0.08)	(0.08)	(0.08)
Adj. R-Squared	0.029	0.030	0.032	0.033
Observations	2075	2075	2075	2075

Linear probability model. Dependent variable: *Still open* is a dummy variable that equals 1, if the business was still open at the follow-up interview and zero, if otherwise. Independent variables: *profits per worker* is winsorized *profits* divided by the number of persons working regularly in the shop, *education level* is measured from 0 (no education or incomplete primary) to 5 (university) and *financial literacy* is a standardized score based on seven knowledge questions. All variables measured in UGX are winsorized at the value 0 and at 99%. Omitted category for *sector* is retail. Standard errors clustered at trading center level (108 clusters).

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

### 3.4 Results looking backward

We complement our analysis by also looking backwards at businesses that have existed for several years, analyzing the role of risk tolerance for them. Due to the kind of data we use, this analysis is limited because of “survivorship bias.” Different from the preceding Section 3.3, where we observe surviving and failing businesses, here we only see survivors. This implies a positive selection of entrepreneurs and their businesses. That means these businesses perform probably better than those which were closed, and which we cannot observe anymore. So what we can see is whether there is a difference between those which survived “long-term” vs those surviving rather “short-term.” However, all the information we have about entrepreneurs and their businesses are from the last year only, so that we hesitate to draw conclusions about the development of businesses over time.

As a proxy for business age, we rely on information regarding how many months the entrepreneur has been running their current business. This proxy underestimates true age, for example when current entrepreneurs take over a business from within the family. Still, we take this information and see that about half of the sample already existed three years ago (probably the true share is larger). Basically, we expect the same three relations that we know from above: (i) older businesses, i.e., those operating for at least three years, are more profitable; (ii) these entrepreneurs may be somewhat more risk tolerant; and (iii) the inferior combination of high risk tolerance and low profitability may tentatively disappear over time.

Table 5 replicates Table 3, but divides the sample by business age. Results are similar to those in Section 3.3: older businesses are characterized by higher profitability, as the profits per worker are, on average, 148,000 UGX for older businesses and 103,000 UGX for younger ones; further, they are characterized by higher investments. Entrepreneurs of older businesses are also older and more experienced, but not better educated. Regarding risk tolerance, there is not a strong difference: the mean value of risk tolerance for entrepreneurs operating older businesses is slightly higher at 4.98 relative to 4.90 for the other entrepreneurs.

Table 5: Descriptive statistics for business age

	At least 3 years (1)	Younger than 3 years (2)	Diff. (3)
Profits per worker (in 1000 UGX)	147.59	102.62	-44.97***
Profits last month (in 1000 UGX)	194.42	129.89	-64.53***
Financial risk tolerance	4.98	4.90	-0.09
Female	0.60	0.68	0.08***
Age (in years)	37.15	30.20	-6.94***
Education level (0-5)	1.37	1.56	0.20***
Financial literacy (std.)	0.04	-0.03	-0.07
Work experience (in months)	124.70	40.01	-84.70***
Able to borrow 100,000 UGX (share)	0.87	0.85	-0.03*
Financial shock cost (in 1000 UGX)	160.10	109.68	-50.42***
Age of business (in months)	94.92	13.55	-81.37***
Sector: retail (share)	0.71	0.68	-0.03
Sector: services (share)	0.24	0.29	0.05***
Sector: manufacturing (share)	0.06	0.03	-0.02**
Investments last 12 months (in 1000 UGX)	1639.14	1204.75	-434.39***
Observations	1076	1068	2144

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ ; p-values are obtained using twosided t-tests.

*Profits per worker* is winsorized *profits* divided by the number of persons working regularly in the shop. *At least 3 years* are all businesses that exist for at least three years, *younger than 3 years* are all businesses that are younger than that. *Financial risk tolerance* is measured on a scale from zero to ten. *Education level* is measured from 0 (no education or incomplete primary) to 5 (university). All variables measured in UGX are winsorized at the value 0 and at 99%. *Financial literacy* is a standardized score based on seven knowledge questions.

Finally, we analyze the (*ex post*) relation between risk tolerance and profitability in more detail, by splitting the age groups into finer intervals. The results presented in Figure 4 tend to confirm expectations about the effect of market forces: First, the lines for older businesses lie quite consistently above those for younger businesses, reflecting their higher profitability; an exception are the two bottom lines, i.e., profit levels of businesses less than a year old and those one to two years old, which are almost identical. Second, regarding the curvature of these lines, the lines for the oldest businesses tend to be somewhat less curved at the risk tolerant end. This applies to businesses that are four to six years old and is very obvious for those older than six years as there is no longer any curvature. This seems to indicate another impact of market forces: in the longer run the profitability of

surviving small businesses operated by highly risk tolerant entrepreneurs becomes similar to the level of business operated by moderately risk tolerant entrepreneurs.

Thus, this analysis indicates two consequences of market dynamics, plausibly at work in the low-income rural area: first, market forces drive out businesses with lower profitability and, second, market forces drive out businesses which are characterized by very high risk tolerance of their entrepreneurs and profitability being below that of entrepreneurs with moderate risk tolerance.

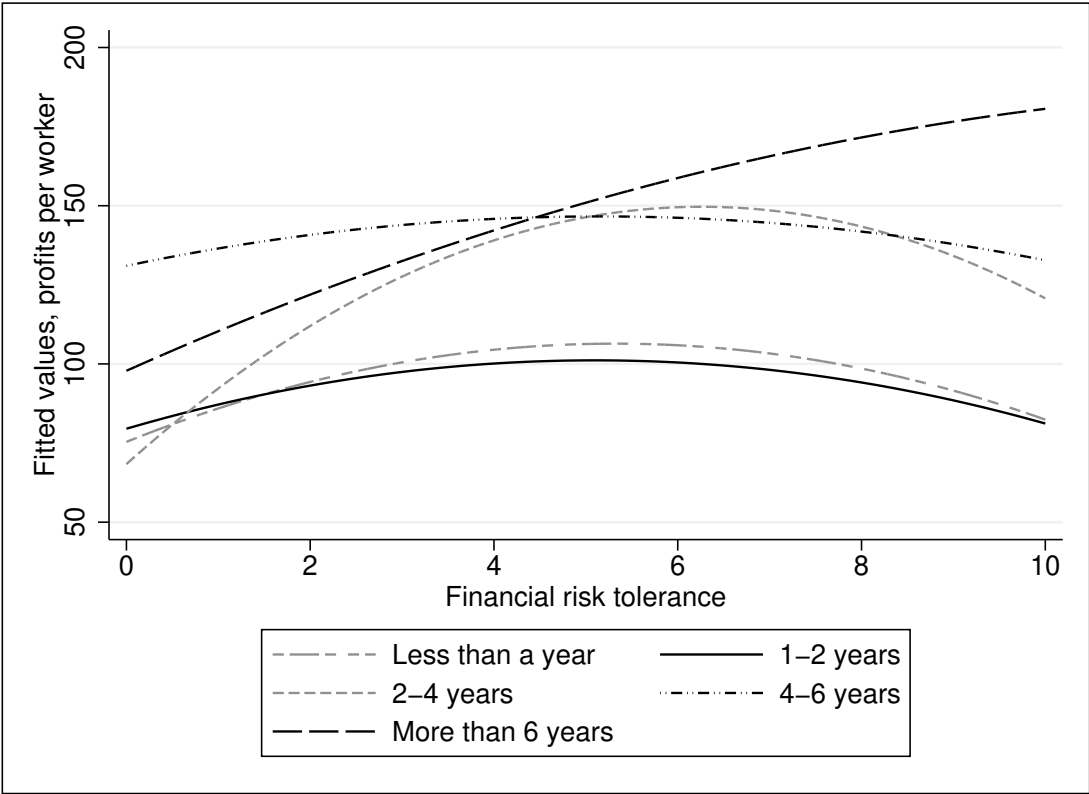


Figure 4: Regressing profits per worker on risk tolerance separately for different ages

## 4 Robustness

We provide a set of robustness checks that tentatively confirm the above findings and which go into eight directions: (i) including risk tolerance in three or four categories instead of using the quadratic term; (ii) using a measure for general risk tolerance; (iii) using other information to consider a possible influence from financial shocks; (iv) taking the skewness of variables more into account by using hyperbolic sine transformation instead of winsorizing; (v) testing main results for surviving entrepreneurs; (vi) considering the financial education treatment as an additional variable to predict business survival; (vii) also considering information about borrowing to see whether an exit is possibly related to overborrowing; (viii) testing how risk tolerance and profits are related to planned instead of past investments.

(i) Applying a quadratic functional relation between risk tolerance and profits is to some extent arbitrary, so that we also group the survey responses on risk tolerance into categories, thus avoiding any functional relation. In line with the other experimental work (as argued in Section 2.2) and as proposed by referees, we apply three categories. These cover entrepreneurs with little risk tolerance (survey responses 0 to 5), entrepreneurs with medium (6 and 7) and high risk tolerance (8 to 10). Results in Table 6 show what we have seen in earlier figures and regressions: profits are highest for the group of entrepreneurs with medium risk tolerance and they are lower for those with little or high risk tolerance. This also holds when we split those with little risk tolerance in two groups or if we shift the borders of groups by one category (see Appendix Tables A3 and A4).

(ii) In the main text, we use the risk measure that asks for the stance toward financial risk. We think that this is an appropriate risk measure in the realm of entrepreneurship. However, one may argue that financial aspects are a bit narrow – even in the context of running a small business – and that a general risk measure provides a broader measure of risk tolerance (see [Dohmen et al., 2011](#)). Thus, we replace the financial risk measure in the main specifications of Table 2 with the general risk measure. Results in Table 7 show that this does not make a qualitative difference.

Table 6: Profits per worker and profits – financial risk tolerance in three groups

	Profits per worker			Profits		
	(1)	(2)	(3)	(4)	(5)	(6)
Fin. tolerance, level 6-7	12.17 (9.18)	5.31 (8.27)	4.81 (7.50)	20.08* (11.07)	10.95 (10.31)	10.27 (8.98)
Fin. tolerance, level 8-10	4.60 (10.73)	-9.37 (9.84)	-8.07 (10.04)	24.76 (15.07)	3.81 (13.03)	5.57 (13.58)
Female		-52.24*** (8.10)	-41.76*** (6.76)		-79.82*** (9.95)	-65.62*** (8.16)
Age (in years)		3.23** (1.61)	1.97 (1.31)		4.09** (1.97)	2.39 (1.58)
Age squared		-0.05** (0.02)	-0.03** (0.02)		-0.06*** (0.02)	-0.05*** (0.02)
Education level (0-5)=1		13.39** (6.28)	5.38 (6.31)		15.00* (7.71)	4.15 (8.04)
Education level (0-5)=2		39.25*** (11.20)	27.85** (11.65)		42.94*** (11.69)	27.50** (12.08)
Education level (0-5)=3		76.85*** (24.37)	68.79*** (20.96)		82.68*** (26.59)	71.78*** (22.04)
Education level (0-5)=4		61.97*** (18.39)	43.23** (19.02)		100.17*** (22.90)	74.78*** (22.60)
Education level (0-5)=5		148.22** (58.33)	123.40** (58.42)		193.48*** (64.51)	159.86** (64.11)
Financial literacy (std.)		11.27*** (4.03)	5.44 (3.50)		14.56*** (4.48)	6.65 (4.15)
Work experience (in months)		0.07 (0.06)	0.05 (0.06)		0.14* (0.07)	0.11 (0.08)
Able to borrow 100,000 UGX (share)		21.38** (8.31)	15.01* (8.28)		27.23** (11.05)	18.60* (10.90)
Financial shock cost (in 1000 UGX)		0.00 (0.01)	-0.00 (0.01)		0.01 (0.02)	-0.00 (0.01)
Age of business (in months)		0.23** (0.10)	0.23*** (0.08)		0.30*** (0.11)	0.29*** (0.10)
Sector: services		-21.30*** (6.29)	-6.68 (6.48)		-26.61*** (8.32)	-6.81 (8.40)
Sector: manufacturing		-41.49** (16.48)	-24.62* (14.75)		-51.33*** (18.90)	-28.48* (16.90)
Investments last 12 months (in 1000 UGX)			0.02*** (0.00)			0.03*** (0.00)
Constant	121.87*** (6.08)	50.35 (33.80)	54.93* (28.03)	154.15*** (7.14)	77.09* (41.17)	83.30** (34.65)
Adj. R-Squared	-0.000	0.085	0.168	0.001	0.112	0.212
Observations	2144	2144	2144	2144	2144	2144

Dependent variables: *profits* is winsorized at the value zero and at 99%, *profits per worker* is *profits* divided by the number of persons working regularly in the shop. Independent variables: *education level* is measured from 0 (no education or incomplete primary) to 5 (university) and *financial literacy* is a standardized score based on seven knowledge questions. All variables measured in UGX are winsorized at the value 0 and at 99%. Omitted category for *sector* is retail. Standard errors clustered at trading center level (108 clusters).

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 7: Profits per worker and profits – general risk tolerance (scale from 0 to 10)

	Profits per worker			Profits		
	(1)	(2)	(3)	(4)	(5)	(6)
General risk tolerance	12.81*** (3.49)	10.06*** (3.27)	6.73* (3.45)	13.84*** (4.87)	10.64** (4.72)	6.12 (4.93)
General risk squared	-0.84** (0.38)	-0.83** (0.36)	-0.47 (0.38)	-0.65 (0.53)	-0.70 (0.51)	-0.22 (0.53)
Female		-51.74*** (8.01)	-41.20*** (6.68)		-79.03*** (9.88)	-64.71*** (8.09)
Age (in years)		3.10* (1.60)	1.91 (1.31)		3.96** (1.95)	2.34 (1.57)
Age squared		-0.04** (0.02)	-0.03** (0.02)		-0.06*** (0.02)	-0.05*** (0.02)
Education level (0-5)=1		12.40* (6.27)	4.60 (6.24)		13.67* (7.64)	3.08 (7.93)
Education level (0-5)=2		38.14*** (11.25)	26.96** (11.64)		41.41*** (11.77)	26.22** (12.09)
Education level (0-5)=3		75.96*** (24.54)	68.19*** (21.12)		81.27*** (26.78)	70.71*** (22.19)
Education level (0-5)=4		59.90*** (18.27)	41.23** (18.89)		97.48*** (22.89)	72.11*** (22.46)
Education level (0-5)=5		148.05** (58.41)	122.57** (58.82)		193.76*** (64.31)	159.13** (64.24)
Financial literacy (std.)		10.91*** (4.07)	5.18 (3.54)		14.14*** (4.53)	6.36 (4.20)
Work experience (in months)		0.08 (0.06)	0.05 (0.06)		0.15** (0.07)	0.11 (0.08)
Able to borrow 100,000 UGX (share)		17.59** (8.15)	11.80 (8.18)		22.92** (11.10)	15.06 (11.07)
Financial shock cost (in 1000 UGX)		0.00 (0.01)	-0.00 (0.01)		0.01 (0.02)	-0.00 (0.01)
Age of business (in months)		0.22** (0.09)	0.22*** (0.08)		0.29*** (0.11)	0.29*** (0.10)
Sector: services		-20.62*** (6.33)	-6.35 (6.52)		-25.69*** (8.32)	-6.30 (8.43)
Sector: manufacturing		-39.27** (16.40)	-22.40 (14.69)		-48.80** (18.94)	-25.88 (17.07)
Investments last 12 months (in 1000 UGX)			0.02*** (0.00)			0.03*** (0.00)
Constant	87.54*** (7.76)	31.64 (32.87)	39.62 (27.55)	112.64*** (11.53)	54.63 (41.48)	65.48* (35.59)
Adj. R-Squared	0.006	0.087	0.170	0.008	0.114	0.215
Observations	2144	2144	2144	2144	2144	2144

Dependent variables: *profits* is winsorized at the value zero and at 99%, *profits per worker* is *profits* divided by the number of persons working regularly in the shop. Independent variables: *education level* is measured from 0 (no education or incomplete primary) to 5 (university) and *financial literacy* is a standardized score based on seven knowledge questions. All variables measured in UGX are winsorized at the value 0 and at 99%. Omitted category for *sector* is retail. Standard errors clustered at trading center level (108 clusters).

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

(iii) As risk tolerance depends on the experience of recent shocks, we consider such shocks by the estimated financial costs of the shock, as shown in Table 2. Now we replace this variable with three alternatives. These are, first, the costs of the financial shock relative to monthly consumption expenses; second, the number of months the business was open in the last 12 months (for businesses older than 12 months); and, third, the self-assessment whether the last four weeks before the survey brought low or high profits relative to the average of the last year, measured on a scale from 0 to 10. Results are shown in Table 8. We do not find that shock amount relative to monthly consumption expenses is significantly related to profitability. For the other two shock alternatives, effects are as expected: “months the shop was open” is positively related to profits and the assessment that “last month was a good month” as well. The U-shaped relationship between risk tolerance and profitability as well as the mediating effect of investments remain qualitatively unchanged.

(iv) We address the fact of a few extreme values and skewness in some nominal variables, e.g., profits, by winsorizing them at the 99% level. This is a standard procedure with data where values may be distorted because of incorrect entrances, misleading memories of participants, misunderstandings, or just extreme cases (outliers). However, it does not reduce skewness tremendously. An alternative procedure that takes better account of this latter issue and can transform zero values is the hyperbolic sine transformation. Applying the transformation to all variables measured in UGX, we again replicate Table 2. In Table 9, we report marginal effects calculated as proposed by Norton (2022). The table shows that the main results are robust to the transformations. However, the mediating effect of investments seems a bit muted.

(v) We test if our main results hold if only those businesses that were still open at the follow-up are considered. This considers the fact that the data including the risk measure stem from the baseline survey while the survivorship information is more recent, further increasing the credibility of an exogenous measure of risk tolerance. Table 10 shows that results also hold for this group as all coefficients are very similar to those in Table 2.



Table 8: Additional controls for shocks

	Shock/consump.		Shop open		Bad-Good month	
	(1)	(2)	(3)	(4)	(5)	(6)
Financial risk tolerance	10.89*** (3.48)	7.04* (3.60)	10.92** (4.84)	6.55 (4.89)	7.15** (3.54)	3.86 (3.61)
Financial risk squared	-0.99** (0.39)	-0.64 (0.40)	-0.88 (0.54)	-0.52 (0.55)	-0.65 (0.40)	-0.35 (0.41)
Female	-52.02*** (8.07)	-41.57*** (6.75)	-53.99*** (9.71)	-43.85*** (8.46)	-46.78*** (7.57)	-37.39*** (6.41)
Age (in years)	2.98* (1.64)	1.79 (1.33)	2.20 (2.04)	0.98 (1.68)	3.60** (1.67)	2.43* (1.36)
Age squared	-0.04** (0.02)	-0.03** (0.02)	-0.03 (0.02)	-0.02 (0.02)	-0.05** (0.02)	-0.04** (0.02)
Education level (0-5)=1	13.06** (6.27)	5.22 (6.29)	14.02* (8.31)	5.11 (7.98)	12.14* (6.24)	4.69 (6.13)
Education level (0-5)=2	39.17*** (11.25)	27.74** (11.68)	38.24*** (14.08)	28.03* (14.60)	38.00*** (11.17)	27.30** (11.60)
Education level (0-5)=3	76.34*** (24.48)	68.56*** (21.05)	59.24** (28.00)	52.46** (24.04)	73.30*** (23.46)	66.28*** (20.26)
Education level (0-5)=4	61.88*** (18.38)	43.10** (19.03)	67.63*** (22.90)	50.02** (23.34)	61.49*** (18.23)	43.56** (18.72)
Education level (0-5)=5	148.74** (58.70)	123.13** (58.86)	183.59** (75.93)	161.78** (75.75)	140.55** (56.61)	117.28** (57.27)
Financial literacy (std.)	10.73** (4.10)	5.13 (3.59)	10.67** (5.30)	4.23 (4.68)	7.20* (4.03)	2.19 (3.48)
Work experience (in months)	0.08 (0.06)	0.05 (0.06)	-0.01 (0.07)	-0.03 (0.07)	0.03 (0.06)	0.01 (0.06)
Able to borrow 100,000 UGX (share)	19.44** (8.32)	13.66 (8.27)	25.15** (10.67)	19.45* (10.56)	12.28 (8.02)	7.59 (8.11)
Financial shock cost (in 1000 UGX)			-0.00 (0.01)	-0.01 (0.01)	-0.00 (0.01)	-0.01 (0.01)
Age of business (in months)	0.23** (0.09)	0.23*** (0.08)	0.23** (0.10)	0.25*** (0.09)	0.26*** (0.10)	0.25*** (0.08)
Sector: services	-21.65*** (6.27)	-6.84 (6.45)	-31.17*** (7.85)	-15.06* (8.19)	-19.27*** (6.34)	-5.56 (6.60)
Sector: manufacturing	-41.61** (16.32)	-24.37* (14.63)	-54.47*** (17.83)	-35.74** (16.04)	-39.23** (16.11)	-23.28 (14.89)
Investments last 12 months (in 1000 UGX)		0.02*** (0.00)		0.02*** (0.00)		0.02*** (0.00)
Shock cost rel. to mth. consumption	-0.19 (2.06)	-0.63 (2.18)				
Shop open prev. year (in months)			4.17*** (1.44)	3.66*** (1.33)		
Bad-good month from 1-10					14.42*** (1.83)	12.85*** (1.71)
Constant	33.41 (33.32)	44.27 (27.86)	10.68 (41.73)	27.94 (37.13)	-37.35 (35.97)	-19.74 (29.82)
Adj. R-Squared	0.086	0.169	0.083	0.170	0.118	0.194
Observations	2144	2144	1560	1560	2144	2144

Dependent variables: *Profits per worker* is winsorized *profits* divided by the number of persons working regularly in the shop. Independent variables: *education level* is measured from 0 (no education or incomplete primary) to 5 (university) and *financial literacy* is a standardized score based on seven knowledge questions. All variables measured in UGX are winsorized at the value 0 and at 99%. Omitted category for *sector* is retail. Standard errors clustered at trading center level (108 clusters).

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

Table 9: Inverse hyperbolic transformation instead of winsorizing

	Profits per worker			Profits		
	(1)	(2)	(3)	(4)	(5)	(6)
Financial risk tolerance	38627.16*** (12659.41)	41407.60*** (14198.34)	37364.58*** (14116.18)	79534.50*** (21626.59)	80313.39*** (28828.33)	75677.44*** (29089.32)
Financial risk squared	-4141.34*** (1133.50)	-4585.43*** (1258.41)	-4154.39*** (1245.10)	-6477.18*** (1830.42)	-7291.78*** (2458.93)	-6733.37*** (2458.99)
Female		54600.13** (24299.06)	54753.76** (24326.73)		-165589.04*** (31412.38)	-173887.62*** (32691.43)
Age (in years)		-4684.15 (5171.72)	-5089.23 (5093.32)		666.51 (6641.47)	-93.72 (6862.47)
Age squared		67.84 (63.94)	72.97 (62.27)		-59.74 (85.54)	-52.71 (87.45)
Education level (0-5)=1		28060.72 (23546.20)	25604.13 (23924.00)		64252.42** (31974.00)	62766.00* (33802.20)
Education level (0-5)=2		81896.54** (39276.19)	78184.93** (38814.76)		132043.09*** (38693.16)	131166.51*** (38606.72)
Education level (0-5)=3		421.14 (40445.15)	-5105.99 (39722.14)		46194.93 (69560.14)	36868.63 (71209.74)
Education level (0-5)=4		722.48 (32245.29)	-6678.36 (31819.41)		86330.75* (50959.41)	72720.17 (52548.63)
Education level (0-5)=5		207723.11 (195003.98)	181370.44 (182005.89)		237931.29* (126736.17)	208520.65* (120491.10)
Financial literacy (std.)		25379.20** (12444.19)	22713.01* (12070.74)		79409.91*** (18986.67)	77675.22*** (19505.35)
Work experience (in months)		-161.02 (221.15)	-173.05 (223.34)		331.99 (286.66)	325.01 (302.19)
Able to borrow 100,000 UGX (share)		51438.86 (38920.95)	43120.52 (38682.39)		190392.88*** (51304.11)	182362.12*** (53843.77)
Financial shock cost (in 1000 UGX)		-61.50* (34.17)	-67.41** (33.89)		-82.07 (80.82)	-97.76 (84.09)
Age of business (in months)		164.80 (269.09)	215.72 (267.74)		548.66 (368.92)	678.81* (386.69)
Sector: services		6763.15 (33195.84)	7214.18 (33652.05)		-7361.28 (40819.26)	-6817.04 (43306.08)
Sector: manufacturing		-61490.62* (35556.28)	-56128.99 (37239.14)		-107760.26** (44797.62)	-100690.73** (50048.65)
Investments last 12 months, ihs			8608.82*** (2892.28)			17635.58*** (4872.60)
Observations	2144	2144	2144	2144	2144	2144

Marginal effects reported. Dependent variables: *profits* is transformed using the inverse hyperbolic sine transformation, *profits per worker* is ihs-transformed *profits* divided by the number of persons working regularly in the shop. Independent variables: *education level* is measured from 0 (no education or incomplete primary) to 5 (university) and *financial literacy* is a standardized score based on seven knowledge questions. All variables measured in UGX are transformed using the inverse hyperbolic sine transformation. Omitted category for *sector* is retail. Standard errors clustered at trading center level (108 clusters).

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

Table 10: Main results only for business survivors

	Profits per worker			Profits		
	(1)	(2)	(3)	(4)	(5)	(6)
Financial risk tolerance	14.82*** (4.44)	11.78*** (4.11)	8.33** (4.18)	15.56** (6.05)	11.83** (5.77)	7.30 (5.63)
Financial risk squared	-1.21** (0.49)	-1.19** (0.46)	-0.85* (0.47)	-1.02 (0.64)	-1.06* (0.61)	-0.61 (0.60)
Female		-56.10*** (8.51)	-45.05*** (7.35)		-87.41*** (10.74)	-72.86*** (9.13)
Age (in years)		2.56 (2.00)	1.61 (1.59)		3.49 (2.32)	2.24 (1.78)
Age squared		-0.04 (0.02)	-0.03 (0.02)		-0.06** (0.03)	-0.05** (0.02)
Education level (0-5)=1		14.22** (7.11)	5.26 (7.48)		15.75* (8.54)	3.95 (9.31)
Education level (0-5)=2		37.81*** (12.77)	25.71* (13.36)		42.96*** (13.92)	27.04* (14.18)
Education level (0-5)=3		83.38*** (31.13)	76.48*** (28.11)		92.08** (35.31)	83.00*** (31.14)
Education level (0-5)=4		59.20*** (20.84)	40.12* (21.61)		96.12*** (24.12)	71.03*** (23.80)
Education level (0-5)=5		133.72* (69.57)	105.16 (69.19)		179.14** (76.01)	141.57* (74.67)
Financial literacy (std.)		11.19** (5.15)	4.62 (4.62)		12.74** (5.81)	4.10 (5.46)
Work experience (in months)		0.06 (0.07)	0.00 (0.07)		0.09 (0.09)	0.02 (0.09)
Able to borrow 100,000 UGX (share)		21.47** (10.11)	14.18 (9.77)		30.42** (13.12)	20.83 (12.82)
Financial shock cost (in 1000 UGX)		0.00 (0.01)	-0.00 (0.01)		0.00 (0.02)	-0.01 (0.01)
Age of business (in months)		0.26** (0.11)	0.27*** (0.09)		0.37*** (0.13)	0.39*** (0.12)
Sector: services		-23.15*** (7.46)	-7.71 (7.84)		-31.86*** (8.87)	-11.56 (9.31)
Sector: manufacturing		-42.33** (18.53)	-23.37 (16.62)		-51.12** (20.74)	-26.18 (18.52)
Investments last 12 months (in 1000 UGX)			0.02*** (0.00)			0.03*** (0.00)
Constant	95.06*** (9.61)	49.11 (41.52)	55.09 (34.39)	123.64*** (14.05)	74.16 (48.18)	82.04** (40.11)
Adj. R-Squared	0.003	0.080	0.169	0.004	0.112	0.219
Observations	1741	1741	1741	1741	1741	1741

Dependent variables: *profits* is winsorized at the value zero and at 99%, *profits per worker* is *profits* divided by the number of persons working regularly in the shop. Independent variables: *education level* is measured from 0 (no education or incomplete primary) to 5 (university) and *financial literacy* is a standardized score based on seven knowledge questions. All variables measured in UGX are winsorized at the value 0 and at 99%. Omitted category for *sector* is retail. Standard errors clustered at trading center level (108 clusters).

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

(vi) Here, we show the results on business survival while controlling for the financial education treatment. In the first three columns of Table 11, risk tolerance is measured continuously, in the following three columns it is measured in three groups. For both measures we show the survival determinants if we do not control for the treatment at all (columns 1 and 4), if we control for being invited to the treatment (intention to treat effect, ITT, in columns 2 and 4), and if we control for actually participating in the treatment (treated effect, TOT, in columns 3 and 6). The number of observations goes down in the later columns because not all individuals were invited in some treated trading centers and, additionally, some individuals did not respond to the invitation. We find that moderate risk tolerance (levels 6 to 7) seems to support business survival. Moreover, the financial education treatment does not impact any of the relations of interest, but interestingly has a significantly positive impact on survival.

(vii) We add information about the share of borrowers in each group (survivors vs. non-survivors) alongside the average amount of loans to former Table 3, and show the result in Table 12. This result may be unexpected from the viewpoint of overborrowing concerns. Closed shops are characterized by the same share of borrowers but by much smaller loan amounts, indicating rather a shortage of loans than overborrowing.

(viii) We investigate how stable the relationship between risk tolerance and investments is by also looking at planned investments. In the survey, entrepreneurs were asked how much they plan to invest in their business in the next 12 months. The correlation between past and future investments is very high and significant. Reassuringly, Figure A3 in the appendix shows that planned investments have the inverted u-shape relation to risk tolerance, as past investments used above.

Table 11: Business survival, controlling for financial education training

	Fin. risk tolerance			Fin. risk tolerance groups		
	(1) No	(2) ITT	(3) TOT	(4) No	(5) ITT	(6) TOT
Financial risk tolerance	0.00 (0.01)	0.01 (0.01)	0.01 (0.01)			
Financial risk squared	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)			
Fin. tolerance, level 6-7				0.06*** (0.02)	0.06*** (0.02)	0.06** (0.02)
Fin. tolerance, level 8-10				0.01 (0.03)	0.02 (0.03)	0.02 (0.03)
Female	-0.03* (0.02)	-0.02 (0.02)	-0.01 (0.02)	-0.03** (0.02)	-0.02 (0.02)	-0.01 (0.02)
Age (in years)	0.02*** (0.00)	0.01*** (0.00)	0.02*** (0.00)	0.02*** (0.00)	0.01*** (0.00)	0.02*** (0.00)
Age squared	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)
Education level (0-5)=1	0.02 (0.02)	0.02 (0.02)	0.04 (0.02)	0.02 (0.02)	0.02 (0.02)	0.04 (0.02)
Education level (0-5)=2	0.04* (0.02)	0.04* (0.02)	0.06** (0.03)	0.04* (0.02)	0.04* (0.02)	0.06** (0.03)
Education level (0-5)=3	0.03 (0.04)	0.03 (0.04)	0.05 (0.05)	0.02 (0.04)	0.03 (0.04)	0.05 (0.05)
Education level (0-5)=4	0.05* (0.03)	0.07** (0.03)	0.08** (0.04)	0.06* (0.03)	0.07** (0.03)	0.08** (0.04)
Education level (0-5)=5	-0.02 (0.05)	-0.02 (0.06)	0.03 (0.06)	-0.02 (0.05)	-0.01 (0.06)	0.03 (0.06)
Financial literacy (std.)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Work experience (in months)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)	-0.00*** (0.00)
Able to borrow 100,000 UGX (share)	0.04* (0.02)	0.03 (0.03)	0.01 (0.03)	0.04* (0.02)	0.03 (0.03)	0.01 (0.03)
Financial shock cost (in 1000 UGX)	0.00** (0.00)	0.00*** (0.00)	0.00** (0.00)	0.00** (0.00)	0.00** (0.00)	0.00** (0.00)
Age of business (in months)	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)	0.00*** (0.00)
Sector: services	0.00 (0.02)	0.00 (0.02)	-0.01 (0.03)	0.01 (0.02)	0.00 (0.02)	-0.00 (0.03)
Sector: manufacturing	0.05 (0.03)	0.06* (0.04)	0.03 (0.04)	0.05* (0.03)	0.06* (0.03)	0.03 (0.04)
Investments last 12 months (in 1000 UGX)	0.00** (0.00)	0.00*** (0.00)	0.00** (0.00)	0.00** (0.00)	0.00*** (0.00)	0.00** (0.00)
Invited to training		0.03* (0.02)			0.03* (0.02)	
Took training			0.06*** (0.02)			0.06*** (0.02)
Constant	0.43*** (0.08)	0.40*** (0.09)	0.40*** (0.11)	0.43*** (0.08)	0.41*** (0.09)	0.41*** (0.11)
Adj. R-Squared	0.030	0.033	0.030	0.033	0.037	0.033
Observations	2075	1743	1472	2075	1743	1472

Linear probability model. Dependent variable: *Still open* is a dummy variable that equals 1, if the business was still open at the follow-up interview and zero, if otherwise. Independent variables: *profits per worker* is winsorized *profits* divided by the number of persons working regularly in the shop, *education level* is measured from 0 (no education or incomplete primary) to 5 (university) and *financial literacy* is a standardized score based on seven knowledge questions. All variables measured in UGX are winsorized at the value 0 and at 99%. Omitted category for *sector* is retail. Standard errors clustered at trading center level (108 clusters).

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

Table 12: Descriptive statistics for business survival, including borrowing

	Observed endline (1)	Still open (2)	Closed (3)	Difference (4)
Profits per worker (in 1000 UGX)	125.42	131.14	95.62	-35.52***
Financial risk tolerance	4.95	4.98	4.78	-0.21
Female	0.64	0.63	0.69	0.06**
Age (in years)	33.68	34.21	30.91	-3.29***
Education level (0-5)	1.46	1.48	1.40	-0.08
Financial literacy (std.)	0.01	0.04	-0.11	-0.15**
Work experience (in months)	82.57	84.47	72.65	-11.82**
Able to borrow 100,000 UGX (share)	0.86	0.87	0.82	-0.06**
Financial shock cost (in 1000 UGX)	135.24	143.60	91.70	-51.89***
Age of business (in months)	54.77	57.64	39.77	-17.87***
Sector: retail (share)	0.69	0.69	0.68	-0.01
Sector: services (share)	0.26	0.26	0.29	0.03
Sector: manufacturing (share)	0.05	0.05	0.03	-0.02*
Investments last 12 months (in 1000 UGX)	1433.60	1511.36	1028.27	-483.09***
Share of borrowers	0.14	0.14	0.13	-0.00
Amount of Loan (in 1000 UGX)	57.87	62.36	34.46	-27.90*
Observations	2075	1741	334	2075

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ ; p-values are obtained using twosided t-tests.

*Profits per worker* is winsorized *profits* divided by the number of persons working regularly in the shop. *Observed endline* are all entrepreneurs interviewed at baseline for which we have business information at endline, *still open* are those who are still in business 15 months later and *closed* are those who do not own a shop anymore, who opened another shop or who relocated. *Financial risk tolerance* is measured on a scale from zero to ten. *Education level* is measured from 0 (no education or incomplete primary) to 5 (university). All variables measured in UGX are winsorized at the value 0 and at 99%. *Financial literacy* is a standardized score based on seven knowledge questions.

## 5 Conclusion

This research addresses the role of risk tolerance for the success of small business entrepreneurs. It is known that the willingness to take risks is crucial for most entrepreneurs, especially if they are not forced to become an entrepreneur, the so-called necessity entrepreneurs. Thus, entrepreneurs tend to be more risk tolerant than the average population, but does this imply that being more risk tolerant is always superior? Alternatively, is it conceivable that risk tolerance is beneficial but that there can be too much of a good

thing? In theory, there should be no reason why risk seeking behavior leads to higher profitability than risk neutral decision making. Rather, high risk tolerance may be similar to the cases of confidence or optimism, both being characteristics that are useful in moderate form but can become detrimental if there is too much confidence and optimism.

Analyzing this issue, we make use of survey data for about 2,100 small entrepreneurs in Western Uganda. We find that both low and high risk tolerance come with lower profitability than moderate risk tolerance, which yields graphically an inverted U-shape relationship between risk tolerance and profitability. Reassuringly, this relation is confirmed when we control for a set of individual and business characteristics. An important transmission channel from risk tolerance to profitability appears to go via investments. Thus, we contribute to the literature by analyzing the impact of risk tolerance on profitability, allowing for non-linearity, controlling for relevant variables, and identifying a transmission channel.

Adding insights about market dynamics, we also observe these entrepreneurs during a second survey wave more than 18 months later and find that those closing their business are mainly less profitable (and invested less) than the survivors. Additionally, other characteristics hint in the expected direction; for example, that closing entrepreneurs have less education. Regarding risk tolerance, we find that those surviving more often tend to have a moderate degree of risk tolerance. Moreover, the businesses already being in operation for a long time, i.e., four years or longer, do not show the strong decrease in profitability for high risk tolerant entrepreneurs. This indicates that market forces may work against the high price, i.e., relatively low profitability, to be paid by risk seeking entrepreneurs.

These findings are relevant for active and future entrepreneurs. While earlier trainings often motivated to take risks in order to run a successful small business, our results suggest to also limit the willingness to take risks and that this limitation is not just a theoretical concept but applies to real world data. Findings also, cautiously, suggest to emphasize the necessity of sufficient investments for a successful and sustainable enterprise.

Overall, high risk tolerance leads to lower entrepreneurial profitability in the cross-section, as does low risk tolerance. Consequently, reflecting market forces, relatively profitable businesses survive more often than others. In the long run, market forces may even drive out businesses characterized by high risk tolerance but only medium profitability, so that the observed inverted U-shape relation between risk tolerance and profitability describes the cross-section but not necessarily a longer-term equilibrium of business development.

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# Appendix (Electronic Supplementary Material)

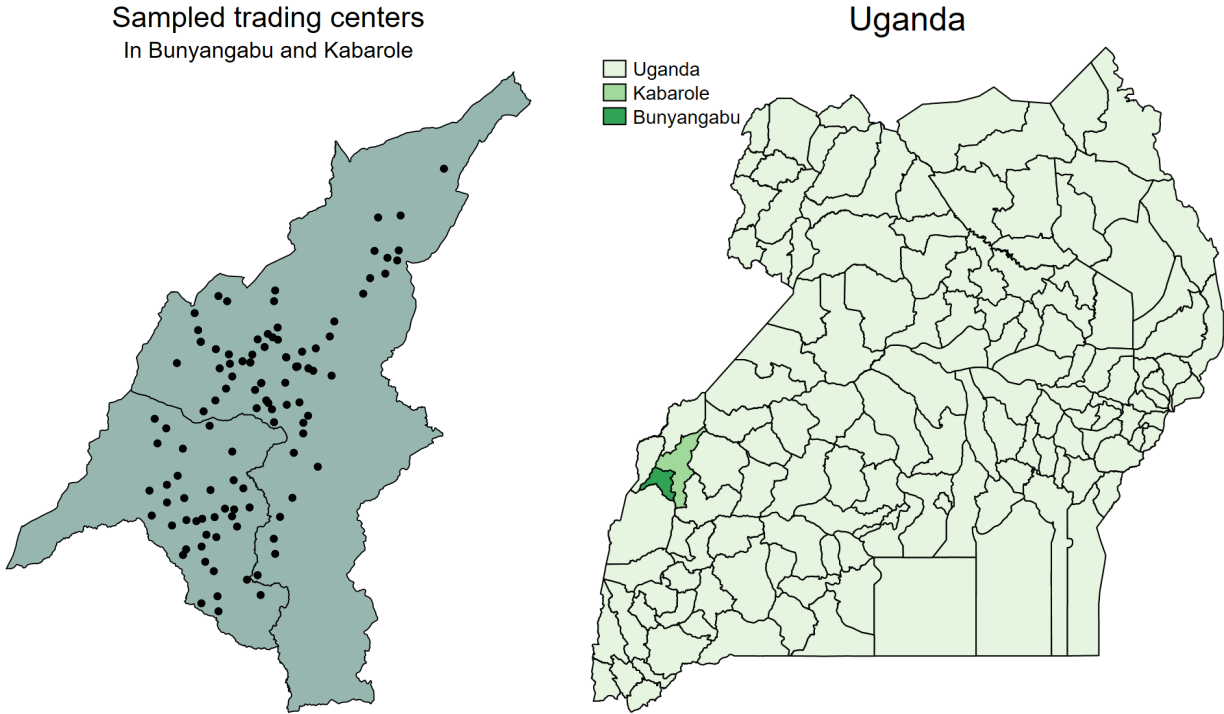


Figure A1: Maps of sampled trading centers in Western Uganda

Table A1: Description of independent variables

<b>Financial risk tolerance</b>	Answer to the question “When thinking about investing and borrowing, are you a person who is fully prepared to take risks or do you try to avoid taking risk?” on a scale from 0-completely unwilling to take risks to 10-fully prepared to take risk.
<b>General risk tolerance</b>	Answer to the question “Are you generally a person who is fully prepared to take risks or do you try to avoid taking risk?” on a scale from 0-completely unwilling to take risks to 10-fully prepared to take risk.
<b>Female</b>	Dummy that takes the value 1 if the respondent is female and 0 otherwise.
<b>Age (in years)</b>	Age of the respondent in years.
<b>Education level (0-5)</b>	Educational attainment of the respondent: 0-none or incomplete primary education, 1-primary education, 2-lower secondary education, 3-upper secondary education, 4-some tertiary education, 5-completed tertiary education.
<b>Financial literacy (std.)</b>	Standardized financial literacy score based on the following questions:
1	<p>What are 10 percent of 200,000 UGX?</p> <p>DO NOT READ ANSWERS</p> <ul style="list-style-type: none"> <li>-Gives right answer (20,000 UGX) quickly</li> <li>-Gives right answer after a while</li> <li>-Gives wrong answer _____</li> <li>-Does not try to answer</li> </ul>
2	<p>Suppose you borrow 100,000 UGX at an interest rate of 2% per month, with no repayment for 3 months. After 3 months, do you owe</p> <ul style="list-style-type: none"> <li>-less than 102,000 UGX,</li> <li>-exactly 102,000 UGX,</li> <li>-or more than 102,000 UGX?</li> </ul>

- 3 Imagine you have 100,000 UGX in a savings account earning 1% interest per year, and prices for goods and services rise 2% over a 1-year period. After one year, how much could you buy with this money?
- More than I could buy today
  - Less than I could buy today
  - The same amount that I could buy today
- 4 Is it riskier to plant
- multiple crops or
  - one crop?
- 5 Suppose you need to borrow 500,000 UGX. Two people offer you a loan. Which loan represents a better deal for you?
- One loan requires you to pay back 600,000 UGX in 1 month.
  - The second loan requires you to pay back in 1 month 500,000 UGX plus 15% interest.
- 6 Suppose you owe 3,000,000 UGX to a bank. You pay a minimum payment of 30,000 UGX each month. At a monthly interest rate of 1%, how many years would it take to eliminate debt if you took no additional loan??
- Less than 5 years
  - Between 5 and 10 years
  - Between 10 and 15 years
  - Never, you will continue to be in debt
- 7 If you were offered a loan with 5% monthly interest rate and a loan with 20% annual interest rate, which loan would offer better value?
- 5% monthly interest rate
  - 20% annual interest rate

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<b>Work experience (in months)</b>	Answer to the question “How long have you been working in any shop in general?” in months.
<b>Able to borrow 100,000 UGX</b>	Answer to the question “Do you think you could be able to borrow 100,000 UGX in case you want to?” (dummy).

<b>Financial shock cost (in 1,000 UGX)</b>	Answer to the question “How many months ago was the last time you had an unexpected emergency that required for you to pay your own money (such as a burial, a fire or a family member or friend falling sick)? How much did you have to pay?” in UGX.
<b>Age of business (in months)</b>	Answer to the question “How long have you been working in this particular shop?” in months.
<b>Sector</b>	Sector the business operates in: 1-Retail and Wholesale, 2-Services and 3-Manufacturing
<b>Investments last 12 months (in 1,000 UGX)</b>	Answer to the question “How much money have you invested in your business in total during the past 12 months? Investments could be for example new equipment, new furniture or signs for advertising. Investments should not include regular expenditures for buying new supplies/stock. Investments should however include expenditures for restocking that you do on top of your regular restocking.” in UGX.
<b>Number of workers</b>	Answer to the question “How many people including yourself are regularly working in this shop?”
<b>Shop open prev. year (in months)</b>	Answer to the question “How many months was the business in operation during the past 12 months?” in months.
<b>Bad-good month from 1-10</b>	Answer to the question “Compared to the average profits of your business over the past year, would you say these past four weeks were a very bad month, a normal month or a very good month? Please choose one number from a 0 to 10 scale, where 0 means “very bad month, profits very low compared to usual profits” and 10 means “very good month, profits very high compared to usual profits.”

Table A2: Descriptive statistics for observations with and without missing values

	No missings (1)	Missings (2)	Difference (3)
Financial risk tolerance	4.94	3.63	-1.31***
Female	0.64	0.56	-0.08
Age (in years)	33.69	38.94	5.26**
Education level (0-5)	1.46	1.11	-0.35**
Financial literacy (std.)	0.01	-0.23	-0.24**
Work experience (in months)	82.51	117.23	34.72**
Able to borrow 100,000 UGX (share)	0.86	0.76	-0.10**
Financial shock cost (in 1000 UGX)	134.98	238.23	103.24
No. of workers	1.43	1.44	0.02
Age of business (in months)	54.38	69.16	14.78
Sector: retail (share)	0.69	0.73	0.04
Sector: services (share)	0.26	0.20	-0.06
Sector: manufacturing (share)	0.04	0.06	0.02
Observations	2144	79	2223

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ ; p-values are obtained using twosided t-tests.

*No missings* are observations for which all variables used in the analysis are not missing, *missings* are those observations for which some variables have missing values. The table only compares those variables that are never missing for any of the observations except for *age*, which is missing for eight observations. *Financial risk tolerance* is measured on a scale from zero to ten. *Education level* is measured from 0 (no education or incomplete primary) to 5 (university). All variables measured in UGX are winsorized at the value 0 and at 99%. *Financial literacy* is a standardized score based on seven knowledge questions.



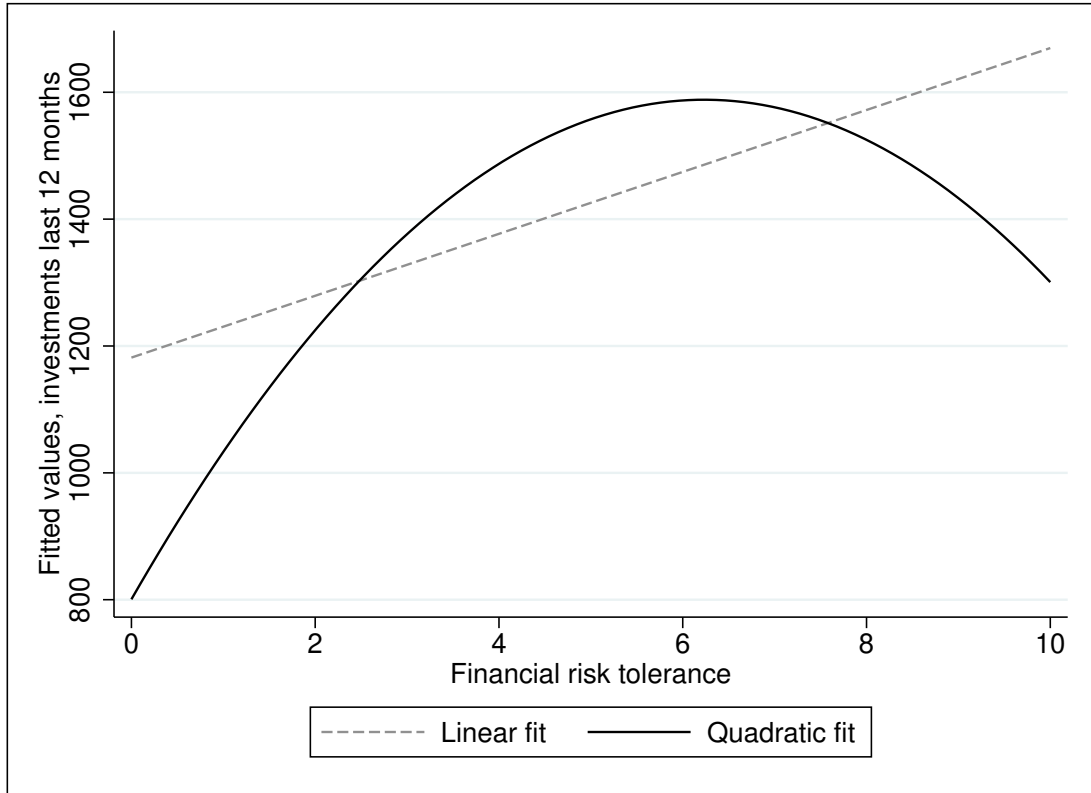


Figure A2: Relation between risk tolerance and past investments

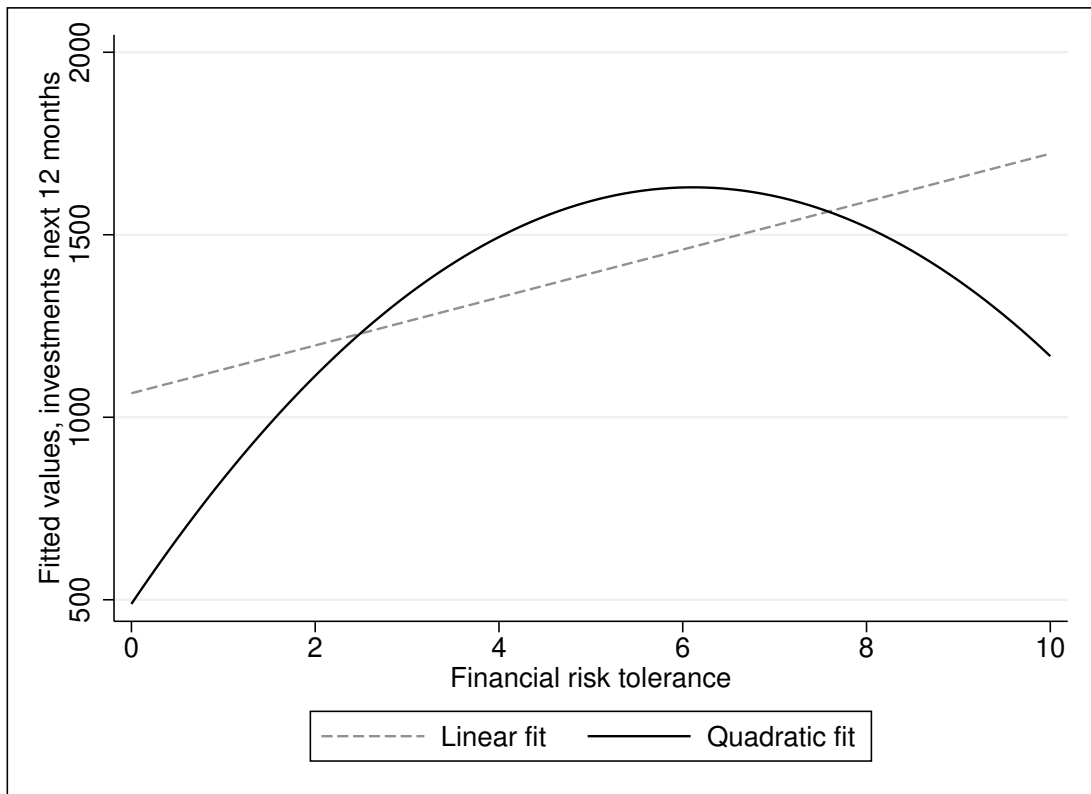


Figure A3: Relation between risk tolerance and future investments

Table A3: Profits per worker and profits – financial risk tolerance in four groups

	Profits per worker			Profits		
	(1)	(2)	(3)	(4)	(5)	(6)
Fin. tolerance, level 4-5	21.37** (8.78)	12.20 (8.33)	5.04 (8.17)	20.49** (9.94)	8.27 (9.42)	-1.45 (9.03)
Fin. tolerance, level 6-7	24.81** (9.83)	12.65 (9.32)	7.84 (8.78)	32.20*** (12.13)	15.93 (11.98)	9.40 (10.90)
Fin. tolerance, level 8-10	17.25 (12.40)	-2.06 (11.70)	-5.06 (11.20)	36.89** (16.40)	8.77 (14.65)	4.70 (14.52)
Female		-52.03*** (8.04)	-41.69*** (6.73)		-79.68*** (9.91)	-65.64*** (8.16)
Age (in years)		3.03* (1.64)	1.89 (1.34)		3.95* (2.00)	2.41 (1.61)
Age squared		-0.04** (0.02)	-0.03** (0.02)		-0.06*** (0.02)	-0.05*** (0.02)
Education level (0-5)=1		13.46** (6.28)	5.42 (6.33)		15.05* (7.72)	4.13 (8.04)
Education level (0-5)=2		39.28*** (11.25)	27.89** (11.68)		42.96*** (11.71)	27.49** (12.09)
Education level (0-5)=3		77.08*** (24.41)	68.91*** (20.98)		82.84*** (26.62)	71.74*** (22.03)
Education level (0-5)=4		62.37*** (18.41)	43.44** (19.05)		100.44*** (22.92)	74.72*** (22.61)
Education level (0-5)=5		148.01** (58.11)	123.36** (58.34)		193.34*** (64.40)	159.87** (64.15)
Financial literacy (std.)		10.89*** (4.06)	5.29 (3.54)		14.30*** (4.51)	6.70 (4.17)
Work experience (in months)		0.07 (0.06)	0.05 (0.06)		0.15* (0.07)	0.11 (0.08)
Able to borrow 100,000 UGX (share)		20.19** (8.31)	14.53* (8.30)		26.43** (11.18)	18.73* (11.10)
Financial shock cost (in 1000 UGX)		0.00 (0.01)	-0.00 (0.01)		0.01 (0.02)	-0.00 (0.01)
Age of business (in months)		0.23** (0.09)	0.23*** (0.08)		0.30*** (0.11)	0.29*** (0.10)
Sector: services		-21.38*** (6.28)	-6.74 (6.48)		-26.67*** (8.31)	-6.80 (8.38)
Sector: manufacturing		-41.06** (16.31)	-24.48* (14.67)		-51.05*** (18.86)	-28.52* (16.91)
Investments last 12 months (in 1000 UGX)			0.02*** (0.00)			0.03*** (0.00)
Constant	109.22*** (6.68)	47.56 (33.33)	53.77* (27.69)	142.02*** (8.59)	75.20* (40.75)	83.63** (34.38)
Adj. R-Squared	0.002	0.085	0.168	0.002	0.112	0.212
Observations	2144	2144	2144	2144	2144	2144

Dependent variables: *profits* is winsorized at the value zero and at 99%, *profits per worker* is *profits* divided by the number of persons working regularly in the shop. Independent variables: *education level* is measured from 0 (no education or incomplete primary) to 5 (university) and *financial literacy* is a standardized score based on seven knowledge questions. All variables measured in UGX are winsorized at the value 0 and at 99%. Omitted category for *sector* is retail. Standard errors clustered at trading center level (108 clusters).

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

Table A4: Profits per worker and profits – financial risk tolerance in three groups (shifted by one)

	Profits per worker			Profits		
	(1)	(2)	(3)	(4)	(5)	(6)
Fin. tolerance, level 7-8	10.89 (9.61)	1.77 (8.74)	-2.44 (8.32)	32.90*** (12.51)	20.16* (10.93)	14.48 (9.33)
Fin. tolerance, level 9-10	2.88 (14.71)	-10.23 (13.89)	-5.27 (14.08)	19.23 (20.92)	-0.94 (18.94)	5.76 (19.51)
Female		-52.29*** (8.09)	-41.69*** (6.76)		-80.02*** (9.96)	-65.68*** (8.16)
Age (in years)		3.27** (1.61)	2.00 (1.31)		4.18** (1.98)	2.46 (1.60)
Age squared		-0.05** (0.02)	-0.03** (0.02)		-0.07*** (0.02)	-0.05*** (0.02)
Education level (0-5)=1		13.24** (6.28)	5.42 (6.27)		14.41* (7.68)	3.83 (7.97)
Education level (0-5)=2		39.25*** (11.22)	27.83** (11.67)		43.34*** (11.63)	27.90** (12.11)
Education level (0-5)=3		76.88*** (24.69)	69.25*** (21.32)		82.20*** (26.88)	71.88*** (22.35)
Education level (0-5)=4		61.52*** (18.35)	42.87** (18.98)		99.84*** (23.01)	74.61*** (22.75)
Education level (0-5)=5		147.63** (58.76)	122.68** (58.92)		192.78*** (64.69)	159.04** (64.40)
Financial literacy (std.)		11.32*** (4.07)	5.49 (3.54)		14.66*** (4.50)	6.77 (4.17)
Work experience (in months)		0.07 (0.06)	0.04 (0.06)		0.14* (0.07)	0.11 (0.08)
Able to borrow 100,000 UGX (share)		21.23** (8.32)	15.07* (8.26)		26.55** (11.08)	18.22* (10.92)
Financial shock cost (in 1000 UGX)		0.00 (0.01)	-0.00 (0.01)		0.01 (0.02)	-0.00 (0.01)
Age of business (in months)		0.23** (0.09)	0.23*** (0.08)		0.30*** (0.11)	0.29*** (0.10)
Sector: services		-21.40*** (6.25)	-6.89 (6.49)		-26.31*** (8.19)	-6.68 (8.34)
Sector: manufacturing		-41.24** (16.46)	-24.44 (14.74)		-50.77*** (18.74)	-28.06* (16.80)
Investments last 12 months (in 1000 UGX)			0.02*** (0.00)			0.03*** (0.00)
Constant	123.36*** (5.66)	50.46 (34.10)	55.14* (28.24)	155.71*** (6.64)	76.54* (41.29)	82.87** (34.79)
Adj. R-Squared	-0.000	0.084	0.168	0.002	0.112	0.213
Observations	2144	2144	2144	2144	2144	2144

Dependent variables: *profits* is winsorized at the value zero and at 99%, *profits per worker* is *profits* divided by the number of persons working regularly in the shop. Independent variables: *education level* is measured from 0 (no education or incomplete primary) to 5 (university) and *financial literacy* is a standardized score based on seven knowledge questions. All variables measured in UGX are winsorized at the value 0 and at 99%. Omitted category for *sector* is retail. Standard errors clustered at trading center level (108 clusters).

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$