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RESEARCH ARTICLE

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

Melanie Koch · **Lukas Menkhoff**

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Abstract Entrepreneurs tend to be risk tolerant but is higher risk tolerance always better? In a sample of about 2100 small businesses, we find an inverted U-shaped relation between risk tolerance and profitability. This relationship holds in a simple bilateral regression, and even after controlling 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 both past and 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 4 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 taking too much risk can be detrimental to long-term business success.

Plain English Summary Very high risk tolerance tends to reduce entrepreneurial profit and survival: Entrepreneurs must be willing to take risks in order to run their business successfully. Accordingly, future entrepreneurs are motivated in respective trainings to overcome higher degrees of risk avoidance. Our research contributes to this issue in that we empirically analyze the profitability and survival of small enterprises, depending on the risk tolerance of the respective entrepreneur. We find the expected positive relation between risk tolerance and entrepreneurial profit, however, only up to a certain degree. Thereafter, higher risk tolerance is detrimental to business success, a result to be considered in entrepreneurial trainings.

Keywords Risk tolerance · Entrepreneurs · Profits · Investments

JEL Classification D22 · D81 · L26 · M21

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

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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 (see Knight, 1921). 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 (and that may be also helpful in dealing with uncertainty). 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 often neglected in existing empirical work.

For a deeper understanding of the impact of risk tolerance on profits, we test a possible channel for how risk tolerance exhibits a potentially non-linear profitability pattern. Motivated by previous literature, we look at investments as potential mediator. Investments are risky and thus benefit from risk tolerance. However, risk-seeking entrepreneurs might underestimate the necessity of investments. Therefore, we hypothesize that risk tolerance also has a non-linear effect on investments. In general, we expect that the volume of investments during the preceding year has an influence on profitability. If including investments reduces the influence of risk tolerance, we conclude that investments serve as a mediator variable.

As an extension, we analyze small business survival as a further indicator of business success (beyond profits). This analysis is possible because data on the same subjects were again collected 18 to 24 months after compiling the baseline data. We expect that 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.

The data we use come from a survey study with about 2100 small entrepreneurs in Western Uganda comprising rich information about their business and personal characteristics. All of them are either 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 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 still include total profits for comparison). Regarding risk tolerance, we use 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 regress profit per worker and total profits on financial risk tolerance and a large set of further potential determinants that serve here mainly as control variables. As we are interested in 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, we apply both a linear and a non-linear (quadratic) approach. We indeed find a non-linear impact from risk tolerance on profit per worker and profits. The highest profitability is realized when risk tolerance is somewhat elevated, i.e., has a level of 6 to 7 in a range of 0 to 10, while profitability is lower with less risk tolerance and is also lower with very high risk tolerance, which may be interpreted as risk-loving preferences. Regarding a mediating role of investment, we find that (past and planned) investments themselves show the inverted U-shaped pattern in relation to the risk tolerance that we have seen for profitability. As previously noted, 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). Finally, regarding surviving businesses, we see market forces at work as survivors are more profitable, invest more, and, thus, 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 4 years or longer that the tentatively inefficient combination of high risk tolerance and limited profitability seems to disappear.

The paper comprises six sections. Section 2 provides the theoretical background and the context for this study. Section 3 describes the setting in more detail, the data, and the methodology. In Section 4, we present the main results and discuss potential transmission channels and business survival. Section 5 provides robustness checks while Section 6 concludes.

2 Theoretical background

In this section, we discuss three issues informing about the theoretical background of this research. We start with considerations on the theoretical influence of risk tolerance on business outcomes, then we reason about the context of our research, and finally, we provide a short overview on related literature.

Considerations on theory 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 & Papanikolaou, 2012) or lower innovation-related investments (Caggese, 2012); consequently, lower growth and/or lower profitability follows.

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, 2022). 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.

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

Context of the study The survey underlying this research was conducted in a rural area in Western Uganda that is poor by standards of high-income and many emerging economies. Average monthly household consumption, serving typically four household members, is about 500,000 UGX in our sample, equaling about 400 US dollars in purchasing power terms. This implies that many of these people live close to poverty. It is common in such settings that the share of entrepreneurs who run their small business out of necessity (and

not out of opportunity) is large, in particular that this share is larger than in high-income countries. Necessity and opportunity entrepreneurs differ in their individual characteristics (e.g., Calderon et al., 2017), including their risk tolerance (Caliendo et al., 2009), and respond differently to government policies (see Audretsch et al., 2022).

Another consequence of little development is a lack of proper institutions, meaning that the small businesses we observe are basically all part of the informal sector. They are locally registered, but there are no requirements to license or keep books, never mind auditing, etc. Formal and informal small businesses are quite different, so that informal firms do not automatically become formal firms at a later point in time (Bennett, 2010) and require different policy measures to support them (Laing et al., 2022). Moreover, the area of survey in Western Uganda is characterized by specific cultural norms and regional features, both potentially influencing entrepreneurship (Stuetzer et al., 2014; Verver & Koning, 2024).

Overall, the context of this study is specific and this may impact findings. Still, we argue that studies such as ours compare entrepreneurs with different risk tolerance within a given institutional setting (all firms in the sample operate in the same context), 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 firm survival as found in the existing literature.

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 1600 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, most 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, and those surviving are more similar over time in their profitability.

From a methodological perspective, revealing an impact of risk tolerance on profitability 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, 2002). 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 opti-

mistic 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.

3 Setting, data, and methods

3.1 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 5500 small businesses in 108 trading centers, of which 2223 were interviewed (for a map, see Appendix Fig. A1). The remaining businesses were either not open when the team visited or were left out in the big centers by design.

3.2 Data

The data we collect inform about the entrepreneurs, i.e., the business owners and their small firms. We first present the dependent variables (profits of the small business and profits per worker), then our main independent variable of interest (risk tolerance), followed by further individual characteristics, and additional firm characteristics, including the mediator variable, i.e., investments.

The key firm characteristics that we aim to explain are 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 for profits is an outright question about profits in the last 4 weeks, which is shown to be reliable and easy to compile vis-á-vis alternatives (see De Mel et al., 2009). The number of workers regularly working at the business is directly asked for too, and the profits per worker are calculated from these two survey items.

Our key individual characteristic of interest is financial risk tolerance, as measured by responses to a standard scale of willingness to take risks related to investing and borrowing, ranging between 0 (completely unwilling) and 10 (fully prepared) (see Dohmen et al., 2011). This measure is 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 & Sakha, 2017). For robustness purposes, we also consider the analogous response to willingness to take risk in general.

Further individual characteristics that may influence entrepreneurship or risk-taking are gender (in most countries, women operate businesses less frequently than men), age measured in years (younger individuals tend to be more risk tolerant), and education measured via six levels (better educated tend to be more risk tolerant). Additionally, we look at financial literacy, as captured via a standardized score of equally weighting the responses to seven standard questions about financial issues (as a specific qualification to run a firm). Characteristics also include the individual work experience (counting all kinds of work experience in months)

as an aspect of human capital, alongside the ability to borrow the relatively large amount of 100,000 UGX "in case [they] want to" (indicating access to credit and/or thus the ability to bear risk). 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 5 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.

Further, variables of interest regarding the small businesses directly are business age; here, approximated by the years, the entrepreneur is working in the specific business (as older firms are less risky) and the sector of business, where we distinguish between retail, service, and manufacturing, reflecting main local sectors. Finally, we consider investments by the respective small business, measured here as the investment amount during the last 12 months prior to the survey. This variable serves as the mediator in our analyses. Full details on all individual and firm characteristics are provided in Appendix Table A1.

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 2144 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 document all variables for the main regressions and show that the sample population is 64% female, about 34 years old, the median has a primary education, and the level of financial literacy is low (on average not even four out of seven questions answered correctly) and, on average, has about 7 years of experience working in a shop. About 86% are able to borrow 100,000 UGX (ca. 27$), which is about half of the median monthly, equivalized household consumption.

On average, the shops are less than 5 years old, with the median shop existing for only 3 years, at the time of being surveyed. Most businesses operate in the retail sector (69%), with 26% in the service sector and only a small fraction in manufacturing. The median amount invested in the last 12 months is five times the median profit yielded in the last 4 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 Fig. 1. 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 US. 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 (Haridon & 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 Fig. 1 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.

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	20,000.00

Financial risk tolerance is measured on a scale from zero to ten, and *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

3.3 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

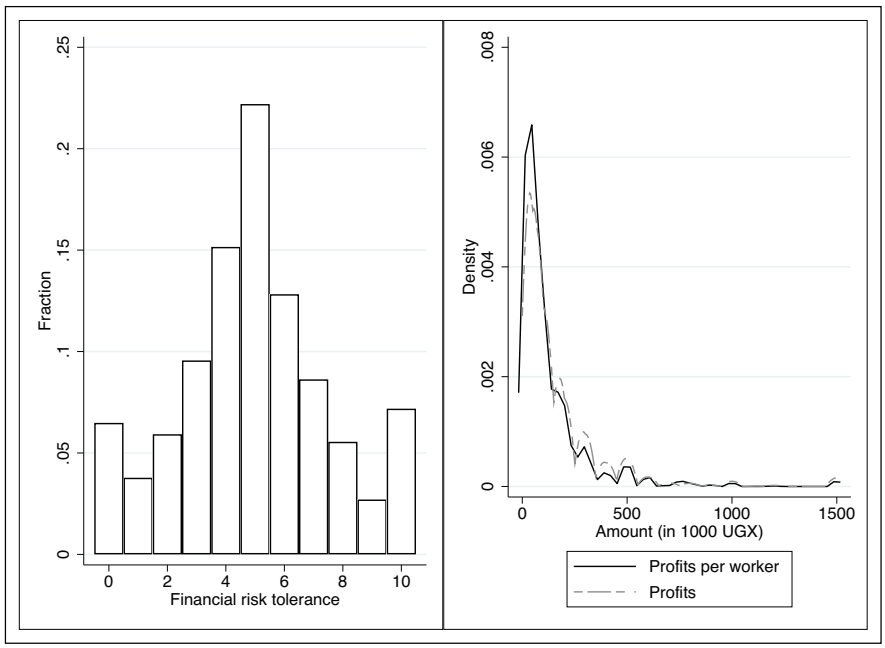

Fig. 1 Histogram for the willingness to take financial risk from 0 to 10 (left) and kernel density estimate for (winsorized) profits per worker and absolute profits (right)

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:

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

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 ϵ 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 4. 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.

4 Results

4.1 Main results

We start the presentation of results by showing the bivariate relation between risk tolerance and profits. In detail, we regress profit per worker and profits on financial risk tolerance, using a linear and a non-linear (quadratic) approach, respectively. The illustration of results in Fig. 2 confirms the expectation that risk-taking and profits go hand in hand. However, when we consider a potentially non-linear relation, this indicates that there may be something like "too much risk toler-

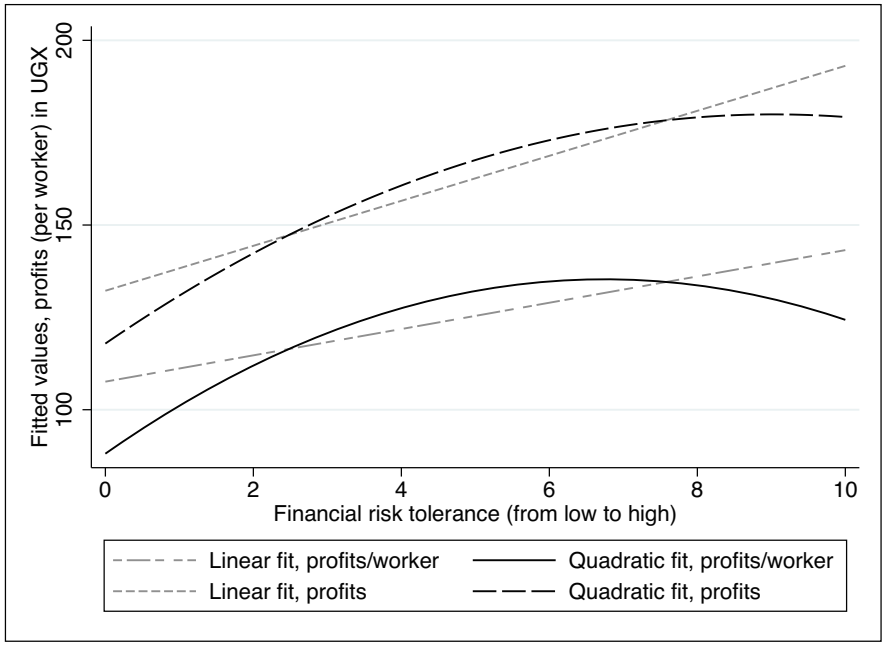

Fig. 2 Regressing profits (per worker) on risk tolerance, linear, and quadratic fit

ance," as risk tolerance above a certain level does not seem to be helpful in realizing higher profitability. The increase in profitability is accompanied by an increase in dispersion (see Fig. A2, in which we show the distribution of profits per worker separately for four risk groups of entrepreneurs).

As the next step, we estimate this relation using the control variables as introduced in Section 3.2. 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 Fig. 2; 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 1500 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 the manufacturing and service sectors 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.

4.2 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 low investment because the need to invest is not seen. 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 & Kenny, 1986). Surprisingly, investments show the same non-linear relation to risk tolerance as that shown in Fig. 2 (see also Appendix Fig. A3). Thus, risk-seeking does not seem to foster too much investment but again too few.

This result is not straightforward; it is in some contrast to the intuitive lack of investment of the risk-averse entrepreneurs. The literature on the consequences of overoptimism indicates that this leads to overinvestment. However, in our context, risk-loving, i.e., in a sense being overly risk tolerant, leads to the opposite: too little investment. One explanation could be that risk-loving entrepreneurs overestimate the impact of their investments and believe they are more successful than they actually are. To test such hypotheses, we would need to know about entrepreneurs' *ex ante* investment expectations which are not available.

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 signif-

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***	10.91***	5.15	13.74**	9.85*	1.07
	(3.72)	(3.48)	(3.62)	(5.42)	(5.31)	(5.35)
Financial risk squared	−1.04**	−1.00**	−0.48	−0.76	−0.76	0.03
	(0.42)	(0.39)	(0.40)	(0.59)	(0.55)	(0.57)
Female		−51.91***	−44.01***		−79.37***	−67.97***
		(8.07)	(7.10)		(9.96)	(8.84)
Age (in years)		2.94*	1.01		3.79*	1.01
		(1.63)	(1.63)		(1.97)	(1.85)
Age squared		−0.04**	−0.02		−0.06***	−0.03
		(0.02)	(0.02)		(0.02)	(0.02)
Education level (0−5)=1		13.15**	5.14		14.88*	2.90
		(6.29)	(6.31)		(7.71)	(7.81)
Education level (0−5)=2		39.08***	27.36**		42.91***	26.58**
		(11.22)	(10.98)		(11.70)	(11.02)
Education level (0−5)=3		76.29***	66.01***		82.40***	68.05***
		(24.57)	(22.94)		(26.77)	(24.69)
Education level (0−5)=4		61.80***	39.23**		100.24***	67.82***
		(18.35)	(17.77)		(22.95)	(21.17)
Education level (0−5)=5		148.50**	113.86**		193.88***	143.66**
		(58.44)	(53.14)		(64.41)	(56.05)
Financial literacy (std.)		10.80***	7.46*		14.08***	8.93**
		(4.10)	(3.97)		(4.54)	(4.39)
Work experience (in months)		0.08	0.05		0.15**	0.12
		(0.06)	(0.06)		(0.07)	(0.08)
Able to borrow 100,000 UGX (share)		19.37**	13.36		25.34**	16.34
		(8.31)	(8.23)		(11.20)	(10.93)
Financial shock cost (in 1000 UGX)		0.00	0.00		0.01	0.01
		(0.01)	(0.01)		(0.02)	(0.02)
Age of business (in months)		0.23**	0.26***		0.30***	0.34***
		(0.09)	(0.10)		(0.11)	(0.11)
Sector: services		−21.38***	−11.35*		−26.66***	−10.87
		(6.26)	(5.89)		(8.24)	(7.17)
Sector: manufacturing		−41.24**	−31.59**		−51.33***	−37.76**
		(16.27)	(14.39)		(18.72)	(15.89)
Investments next 12 months (in 1000 UGX)			0.02***			0.03***
			(0.00)			(0.00)
Constant	88.10***	33.67	66.23**	117.91***	61.31	108.15***
	(7.41)	(33.30)	(32.88)	(12.01)	(41.78)	(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* are winsorized at the value zero and at 99%, *profits per worker* are *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)
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

icant 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 a 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.

4.3 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 a higher probability?

We extend information beyond the cross-section used in Section 4.1 and make use of a follow-up survey wave. This wave contains, however, many 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 were not been surveyed again. Still, we know whether the same small businesses remained in operation.[1] 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 2144 entrepreneurs at baseline, 1904 participated in the endline survey. Of these, 169 respondents reported that they no longer operate their old business.[2] 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.[3] 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

[1] 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.

[2] This sample is divided into two groups, 86 persons no longer run a business and 83 opened a new business.

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

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$; p-values are obtained using two-sided t-tests
Profits per worker are 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

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 that, as expected from Table 3, 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.

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

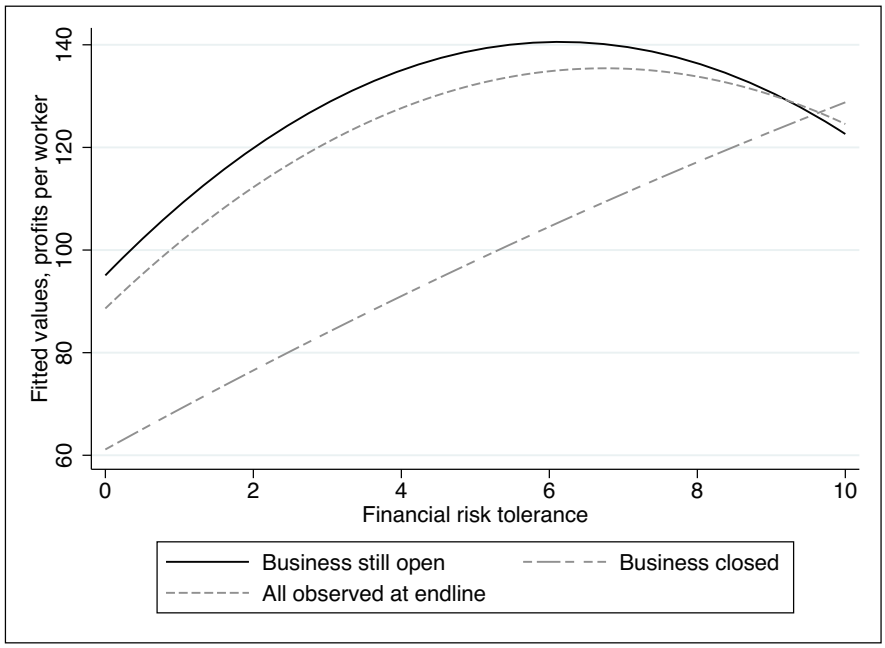

Fig. 3 Regressing profits per worker on risk tolerance, survivors vs non-survivors

their businesses more vulnerable to the heavy crisis of 2020 so that even relatively profitable businesses had to close.

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 3.2, 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 the highest probability to survive, confirming (Caliendo et al., 2010).

4.4 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." Unlike the preceding Section 4.3, 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 that were closed and that we can no longer observe. Thus, what we can see is whether there is a difference between those that survived "long-term" vs those surviving rather "short-term." However, all the information we have about entrepreneurs and their businesses are from only one year, 2019, 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 4.3: older businesses are characterized by higher

Table 4 Business survival, regressions

	Fin. risk tolerance		Fin. risk tolerance groups	
	(1) No mediator	(2) Mediator	(3) No mediator	(4) 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)

Table 4 continued

	Fin. risk tolerance		Fin. risk tolerance groups	
	(1) No mediator	(2) Mediator	(3) No mediator	(4) Mediator
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* are 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)
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

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.

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 Fig. 4 tend to confirm expectations about the effect of market forces: First, the lines for older businesses lie quite consistently above those for younger

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 two-sided t-tests
Profits per worker are 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

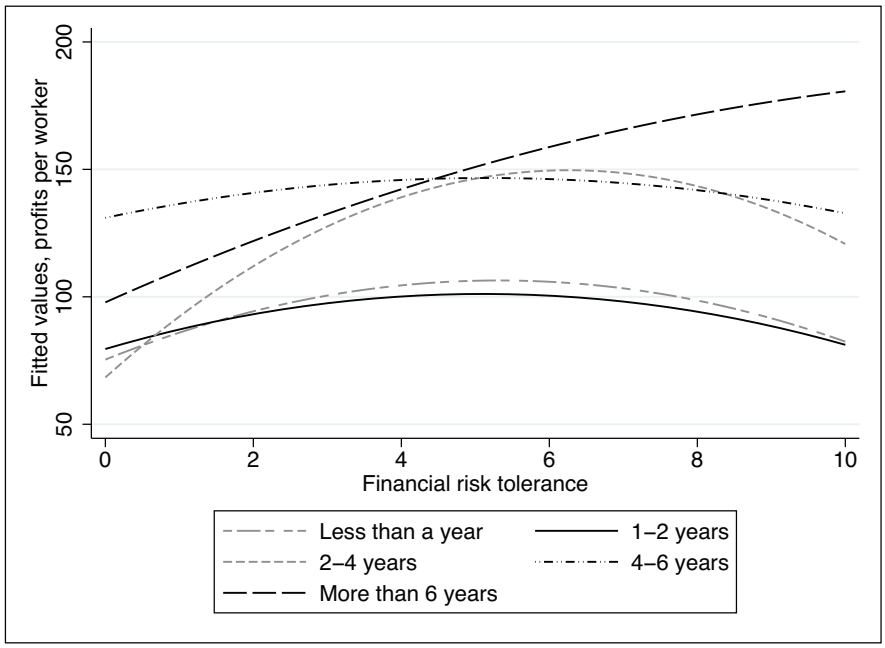

Fig. 4 Regressing profits per worker on risk tolerance separately for different ages

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. It is quite obvious for businesses 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 that are characterized by very high risk tolerance of their entrepreneurs and profitability being below that of entrepreneurs with moderate risk tolerance.

5 Robustness

We provide a set of robustness checks that tentatively confirm the above findings and that go in eight directions: (i) measuring risk tolerance differently by including it in three or four categories instead of using the quadratic term and by using a measure for general risk tolerance; (ii) analyzing the sensitivity of the main results to gender; (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; and (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) 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,

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

	Profits per worker			Profits		
	(1)	(2)	(3)	(4)	(5)	(6)
Fin. risk tolerance, level 6−7	12.17	5.31	4.81	20.08*	10.95	10.27
	(9.18)	(8.27)	(7.50)	(11.07)	(10.31)	(8.98)
Fin. risk tolerance, level 8−10	4.60	−9.37	−8.07	24.76	3.81	5.57
	(10.73)	(9.84)	(10.04)	(15.07)	(13.03)	(13.58)
Female		−52.24***	−41.76***		−79.82***	−65.62***
		(8.10)	(6.76)		(9.95)	(8.16)
Age (in years)		3.23**	1.97		4.09**	2.39
		(1.61)	(1.31)		(1.97)	(1.58)
Age squared		−0.05**	−0.03**		−0.06***	−0.05***
		(0.02)	(0.02)		(0.02)	(0.02)
Education level (0−5)=1		13.39**	5.38		15.00*	4.15
		(6.28)	(6.31)		(7.71)	(8.04)
Education level (0−5)=2		39.25***	27.85**		42.94***	27.50**
		(11.20)	(11.65)		(11.69)	(12.08)
Education level (0−5)=3		76.85***	68.79***		82.68***	71.78***
		(24.37)	(20.96)		(26.59)	(22.04)
Education level (0−5)=4		61.97***	43.23**		100.17***	74.78***
		(18.39)	(19.02)		(22.90)	(22.60)
Education level (0−5)=5		148.22**	123.40**		193.48***	159.86**
		(58.33)	(58.42)		(64.51)	(64.11)
Financial literacy (std.)		11.27***	5.44		14.56***	6.65
		(4.03)	(3.50)		(4.48)	(4.15)
Work experience (in months)		0.07	0.05		0.14*	0.11
		(0.06)	(0.06)		(0.07)	(0.08)
Able to borrow 100,000 UGX (share)		21.38**	15.01*		27.23**	18.60*
		(8.31)	(8.28)		(11.05)	(10.90)
Financial shock cost (in 1000 UGX)		0.00	−0.00		0.01	−0.00
		(0.01)	(0.01)		(0.02)	(0.01)
Age of business (in months)		0.23**	0.23***		0.30***	0.29***
		(0.10)	(0.08)		(0.11)	(0.10)
Sector: services		−21.30***	−6.68		−26.61***	−6.81
		(6.29)	(6.48)		(8.32)	(8.40)
Sector: manufacturing		−41.49**	−24.62*		−51.33***	−28.48*
		(16.48)	(14.75)		(18.90)	(16.90)
Investments last 12 months (in 1000 UGX)			0.02***			0.03***
			(0.00)			(0.00)
Constant	121.87***	50.35	54.93*	154.15***	77.09*	83.30**
	(6.08)	(33.80)	(28.03)	(7.14)	(41.17)	(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* are winsorized at the value zero and at 99%, and *profits per worker* are *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 Main results by gender

	Profits per worker				Profits			
	(1) M	(2) W	(3) M	(4) W	(5) M	(6) W	(7) M	(8) W
Financial risk tolerance	13.03	10.31**	4.50	8.37*	2.89	13.30**	−8.75	10.68*
	(7.96)	(4.83)	(6.99)	(4.76)	(11.42)	(6.68)	(10.14)	(6.40)
Financial risk squared	−1.19	−0.95*	−0.44	−0.77	−0.20	−1.06	0.82	−0.81
	(0.82)	(0.51)	(0.74)	(0.50)	(1.08)	(0.68)	(0.98)	(0.65)
Age (in years)	4.05	1.22	3.04	0.44	6.39	0.55	5.01	−0.51
	(3.76)	(1.39)	(2.77)	(1.31)	(4.63)	(1.88)	(3.43)	(1.77)
Age squared	−0.06	−0.02	−0.05	−0.02	−0.10*	−0.02	−0.08**	−0.01
	(0.04)	(0.02)	(0.03)	(0.01)	(0.05)	(0.02)	(0.04)	(0.02)
Education level (0−5)=1	23.03	10.67	9.93	4.71	24.52	11.25	6.64	3.20
	(17.22)	(8.32)	(15.93)	(7.49)	(21.67)	(9.51)	(19.98)	(9.00)
Education level (0−5)=2	49.83**	35.70***	38.16	24.56**	47.05*	41.18***	31.13	26.11**
	(23.60)	(10.70)	(23.32)	(11.01)	(25.26)	(12.64)	(25.87)	(12.51)
Education level (0−5)=3	107.88***	56.35**	105.73***	44.94**	101.67**	68.73**	98.74***	53.29**
	(40.96)	(25.09)	(36.31)	(22.51)	(40.97)	(29.50)	(34.62)	(25.69)
Education level (0−5)=4	76.54**	52.08***	55.04	36.48**	155.58***	63.84***	126.24***	42.73**
	(35.02)	(15.46)	(36.25)	(14.98)	(46.49)	(20.34)	(43.58)	(20.22)
Education level (0−5)=5	199.30***	105.45*	176.48**	79.49	255.98***	141.83*	224.84***	106.73
	(71.08)	(57.27)	(78.75)	(50.63)	(74.49)	(75.18)	(82.71)	(67.60)
Financial literacy (std.)	7.29	12.81***	−0.94	8.95**	8.67	17.21***	−2.56	11.99**
	(9.36)	(3.97)	(8.26)	(3.72)	(11.15)	(5.01)	(9.87)	(5.00)
Work experience (in months)	0.04	0.14**	−0.01	0.12*	0.05	0.27***	−0.02	0.24**
	(0.11)	(0.06)	(0.09)	(0.07)	(0.13)	(0.09)	(0.11)	(0.10)
Able to borrow 100,000 UGX (share)	41.67**	11.13	35.62**	6.06	49.39*	16.89*	41.13	10.03
	(19.23)	(7.98)	(17.86)	(8.02)	(28.30)	(10.00)	(27.85)	(9.84)
Financial shock cost (in 1000 UGX)	−0.00	0.01	−0.01	0.00	−0.02	0.02	−0.03	0.02
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)
Age of business (in months)	0.31**	0.15	0.35***	0.12	0.46**	0.15	0.51***	0.12
	(0.16)	(0.11)	(0.12)	(0.10)	(0.18)	(0.13)	(0.15)	(0.13)
Sector: services	−46.90***	−7.35	−15.41	−1.11	−59.87***	−6.46	−16.89	1.99
	(12.71)	(6.69)	(12.46)	(6.59)	(16.27)	(8.60)	(16.14)	(8.31)
Sector: manufacturing	−81.09***	−12.43	−52.57**	−3.62	−80.98***	−29.09	−42.07	−17.17
	(25.64)	(21.46)	(23.52)	(20.54)	(29.79)	(22.06)	(28.36)	(21.56)
Investments last 12 months			0.02***	0.02***			0.03***	0.02***
			(0.00)	(0.00)			(0.00)	(0.01)
Constant	−12.86	22.61	−3.44	36.95	16.66	38.29	29.51	57.69
	(71.73)	(31.14)	(54.90)	(28.71)	(89.37)	(44.30)	(67.93)	(41.79)
Adj. R-squared	0.064	0.052	0.167	0.117	0.085	0.067	0.216	0.143
Observations	769	1375	769	1375	769	1375	769	1375

Dependent variables: *profits* are winsorized at the value zero and at 99%, and *profits per worker* are *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 8 Additional controls for shocks

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

Table 8 continued

	Profits per worker			Profits		
	(1) Shock/con.	(2) Shock/con.	(3) Shop open	(4) Shop open	(5) Bad-good month	(6) Bad-good month
Constant	33.41	44.27	10.68	27.94	−37.35	−19.74
	(33.32)	(27.86)	(41.73)	(37.13)	(35.97)	(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* are 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)
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

and they are lower for those with little or high risk tolerance. Interestingly, it remains unclear whether it is "better" (in the sense of generating more profits) to have too high than too low risk tolerance. While results in Table 6, columns 1 and 4 seem to support an interpretation of superior high risk tolerance, when we control for other variables the high-risk group coefficient is positive only for profits (columns 5 and 6) but negative for profits per worker (columns 2 and 3); in any case, all these coefficients are statistically insignificant. 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, so that levels 7 and 8 define the middle group of risk tolerance instead of levels 6 and 7 (see Appendix Tables A3 and A4).

Moreover, one may argue that tolerance toward financial risk is 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, which does not make a qualitative difference in the regression results (see Appendix Table A5).

(ii) Our sample consists to a large extent (64%) of women; they often differ in their characteristics from men, such that a comparison of main results across gender may be interesting. In our setting, gender differences do not seem to be that pronounced. Still, the financial risk tolerance of women is, on average, slightly lower (5.1 for men vs 4.8 for women); their average educational attainment and financial literacy are also lower, and women are less likely to be able to borrow 100,000 UGX (90% vs 84%). This indicates that women are in a weaker position when running their small business. Thus, we analyze whether the structure of the main results (as shown in Table 2) still holds when we repeat the regression but split the sample by gender. The results in Table 7 show that coefficients keep their signs, but are less often significant, in part due to fewer observations per regression. However, there are also some differences across gender that are quite large and consistent throughout the pairwise columns: comparing, for example, columns 3 and 4, the coefficient on financial literacy is about ten times as large for women than for men, or the ability to borrow matters six times more for men than for women (see Liu & Cowling, 2024, forhowinteractioneffectsbetweengenderandconfidencecanshapeaccesstofinance). This cautiously indicates that in our sample women may have different bottlenecks in their entrepreneurial development than men. This also applies to some extent to our main coefficients of interest, i.e., those on financial risk tolerance and its squared term, that tend to be even more important in explaining entrepreneurial profit (per worker) for women relative to men.

(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 4 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

Table 9 Inverse hyperbolic transformation instead of winsorizing

	Profits per worker			Profits		
	(1)	(2)	(3)	(4)	(5)	(6)
Financial risk tolerance	38,627.16***	41,407.60***	37,364.58***	79,534.50***	80,313.39***	75,677.44***
	(12,659.41)	(14,198.34)	(14,116.18)	(21,626.59)	(28,828.33)	(29,089.32)
Financial risk squared	−4141.34***	−4585.43***	−4154.39***	−6477.18***	−7291.78***	−6733.37***
	(1133.50)	(1258.41)	(1245.10)	(1830.42)	(2458.93)	(2458.99)
Female		54,600.13**	54,753.76**		−165,589.04***	−173,887.62***
		(24,299.06)	(24,326.73)		(31,412.38)	(32,691.43)
Age (in years)		−4684.15	−5089.23		666.51	−93.72
		(5171.72)	(5093.32)		(6641.47)	(6862.47)
Age squared		67.84	72.97		−59.74	−52.71
		(63.94)	(62.27)		(85.54)	(87.45)
Education level (0−5)=1		28,060.72	25,604.13		64,252.42**	62,766.00*
		(23,546.20)	(23,924.00)		(31,974.00)	(33,802.20)
Education level (0−5)=2		81,896.54**	78,184.93**		132,043.09***	131,166.51***
		(39,276.19)	(38,814.76)		(38,693.16)	(38,606.72)
Education level (0−5)=3		421.14	−5105.99		46,194.93	36,868.63
		(40,445.15)	(39,722.14)		(69,560.14)	(71,209.74)
Education level (0−5)=4		722.48	−6678.36		86,330.75*	72,720.17
		(32,245.29)	(31,819.41)		(50,959.41)	(52,548.63)
Education level (0−5)=5		207,723.11	181,370.44		237,931.29*	208,520.65*
		(195,003.98)	(182,005.89)		(126,736.17)	(120,491.10)
Financial literacy (std.)		25,379.20**	22,713.01*		79,409.91***	77,675.22***
		(12,444.19)	(12,070.74)		(18,986.67)	(19,505.35)
Work experience (in months)		−161.02	−173.05		331.99	325.01
		(221.15)	(223.34)		(286.66)	(302.19)
Able to borrow 100,000 UGX (share)		51,438.86	43,120.52		190,392.88***	182,362.12***
		(38,920.95)	(38,682.39)		(51,304.11)	(53,843.77)
Financial shock cost (in 1000 UGX)		−61.50*	−67.41**		−82.07	−97.76
		(34.17)	(33.89)		(80.82)	(84.09)
Age of business (in months)		164.80	215.72		548.66	678.81*
		(269.09)	(267.74)		(368.92)	(386.69)
Sector: services		6763.15	7214.18		−7361.28	−6817.04
		(33,195.84)	(33,652.05)		(40,819.26)	(43,306.08)
Sector: manufacturing		−61,490.62*	−56,128.99		−107,760.26**	−100,690.73**
		(35,556.28)	(37,239.14)		(44,797.62)	(50,048.65)
Investments last 12 months, ihs			8608.82***			17,635.58***
			(2892.28)			(4872.60)
Observations	2144	2144	2144	2144	2144	2144

Marginal effects reported. Dependent variables: *profits* are transformed using the inverse hyperbolic sine transformation, *profits per worker* are 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***	11.78***	8.33**	15.56**	11.83**	7.30
	(4.44)	(4.11)	(4.18)	(6.05)	(5.77)	(5.63)
Financial risk squared	−1.21**	−1.19**	−0.85*	−1.02	−1.06*	−0.61
	(0.49)	(0.46)	(0.47)	(0.64)	(0.61)	(0.60)
Female		−56.10***	−45.05***		−87.41***	−72.86***
		(8.51)	(7.35)		(10.74)	(9.13)
Age (in years)		2.56	1.61		3.49	2.24
		(2.00)	(1.59)		(2.32)	(1.78)
Age squared		−0.04	−0.03		−0.06**	−0.05**
		(0.02)	(0.02)		(0.03)	(0.02)
Education level (0−5)=1		14.22**	5.26		15.75*	3.95
		(7.11)	(7.48)		(8.54)	(9.31)
Education level (0−5)=2		37.81***	25.71*		42.96***	27.04*
		(12.77)	(13.36)		(13.92)	(14.18)
Education level (0−5)=3		83.38***	76.48***		92.08**	83.00***
		(31.13)	(28.11)		(35.31)	(31.14)
Education level (0−5)=4		59.20***	40.12*		96.12***	71.03***
		(20.84)	(21.61)		(24.12)	(23.80)
Education level (0−5)=5		133.72*	105.16		179.14**	141.57*
		(69.57)	(69.19)		(76.01)	(74.67)
Financial literacy (std.)		11.19**	4.62		12.74**	4.10
		(5.15)	(4.62)		(5.81)	(5.46)
Work experience (in months)		0.06	0.00		0.09	0.02
		(0.07)	(0.07)		(0.09)	(0.09)
Able to borrow 100,000 UGX (share)		21.47**	14.18		30.42**	20.83
		(10.11)	(9.77)		(13.12)	(12.82)
Financial shock cost (in 1000 UGX)		0.00	−0.00		0.00	−0.01
		(0.01)	(0.01)		(0.02)	(0.01)
Age of business (in months)		0.26**	0.27***		0.37***	0.39***
		(0.11)	(0.09)		(0.13)	(0.12)
Sector: services		−23.15***	−7.71		−31.86***	−11.56
		(7.46)	(7.84)		(8.87)	(9.31)
Sector: manufacturing		−42.33**	−23.37		−51.12**	−26.18
		(18.53)	(16.62)		(20.74)	(18.52)
Investments last 12 months (in 1000 UGX)			0.02***			0.03***
			(0.00)			(0.00)
Constant	95.06***	49.11	55.09	123.64***	74.16	82.04**
	(9.61)	(41.52)	(34.39)	(14.05)	(48.18)	(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* are winsorized at the value zero and at 99%, and *profits per worker* are *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 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. risk tolerance, level 6−7				0.06***	0.06***	0.06**
				(0.02)	(0.02)	(0.02)
Fin. risk tolerance, level 8−10				0.01	0.02	0.02
				(0.03)	(0.03)	(0.03)
Female	−0.03*	−0.02	−0.01	−0.03**	−0.02	−0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Age (in years)	0.02***	0.01***	0.02***	0.02***	0.01***	0.02***
	(0.00)	(0.00)	(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)	(0.00)	(0.00)	(0.00)	(0.00)
Education level (0−5)=1	0.02	0.02	0.04	0.02	0.02	0.04
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Education level (0−5)=2	0.04*	0.04*	0.06**	0.04*	0.04*	0.06**
	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)
Education level (0−5)=3	0.03	0.03	0.05	0.02	0.03	0.05
	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.05)
Education level (0−5)=4	0.05*	0.07**	0.08**	0.06*	0.07**	0.08**
	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)
Education level (0−5)=5	−0.02	−0.02	0.03	−0.02	−0.01	0.03
	(0.05)	(0.06)	(0.06)	(0.05)	(0.06)	(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*	0.03	0.01	0.04*	0.03	0.01
	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)	(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	0.00	−0.01	0.01	0.00	−0.00
	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)
Sector: manufacturing	0.05	0.06*	0.03	0.05*	0.06*	0.03
	(0.03)	(0.04)	(0.04)	(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)

Table 11 continued

	Fin. risk tolerance			Fin. risk tolerance groups		
	(1) No	(2) ITT	(3) TOT	(4) No	(5) ITT	(6) TOT
Invited to training		0.03*			0.03*	
		(0.02)			(0.02)	
Took training			0.06***			0.06***
			(0.02)			(0.02)
Constant	0.43***	0.40***	0.40***	0.43***	0.41***	0.41***
	(0.08)	(0.09)	(0.11)	(0.08)	(0.09)	(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* are 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)
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

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, as is the assessment that "last month was a good month." The U-shaped relationship between risk tolerance and profitability, as well as the mediating effect of investments, remains 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 recordings, 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.

(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

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 two-sided t-tests
Profits per worker are 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

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, Fig. A4 in the Appendix shows that planned investments have the inverted U-shape relation to risk tolerance, just like the past investments used above.

6 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. 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 more success 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.

Our main contribution to the literature is that we analyze this issue by focusing on an often neglected core measure of entrepreneurial success, i.e., profitability. Analyzing this issue, we make use of survey data for about 2100 small entrepreneurs in Western Uganda that provides a large set of variables to isolate the impact from risk tolerance. We find that both low and high risk tolerance come with lower profitability than moder-

ate risk tolerance, which yields graphically an inverted U-shape relationship between risk tolerance and profitability. 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 by analyzing the impact of risk tolerance on profitability, allowing for non-linearity, controlling for relevant variables, and identifying a transmission channel via investments.

We further add insights about market dynamics to the literature, as we also observe these entrepreneurs during a second survey wave more than 18 months later and find that those closing their business are mostly less profitable (and invest less) than the survivors. Typically, surviving entrepreneurs tend to have a moderate degree of risk tolerance. Moreover, the businesses having already been in operation for a long time, i.e., 4 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 relatively low profitability being realized by risk-seeking entrepreneurs.

We acknowledge that our findings stem from a survey in a specific environment. Economic relations derived from entrepreneurs in rural Western Uganda may not hold in other places of the world. The survey area is relatively poor compared to high-income economies but not that particular for the majority of people living in low-income economies. The low incomes go along with a large share of so-called necessity entrepreneurs, who do not aim for realizing a great business idea but rather look for a possibility to earn some money. That share is usually much lower in high-income economies. Moreover, small businesses in low-income countries are typically informal firms, which also applies to our sample. Thus, there is hardly any bookkeeping, and very often, financial flows cannot be clearly separated between the business and the private domain. This fact also makes analyses imprecise. Finally, like in all case studies, there are context-specific factors that may impact results in directions that are difficult to control for.

Acknowledging these limitations, we still argue that our results may be generalizable to some extent. This optimism is based on the clear determinants of profitability that we find in the data, such as better education, financial literacy or access to finance of the entrepreneur, and higher age of the firm. These determinants are consistent with economic theory and many empirical studies, so that we regard them as a kind of stylized facts. Given this credible structure in the data, there is no strong reason why only the non-linear relation from risk tolerance to profitability should be specific to our sample.

The findings of this study are relevant for active and future entrepreneurs. While earlier trainings often encouraged risk-taking 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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Declarations

Conflict of interest The authors declare no competing interests.

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