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Credit-constrained in risky activities? The determinants of capital stocks of micro and small firms in Western Africa

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Abstract

Micro and small enterprises (MSEs) in developing countries are typically considered to be severely credit-constrained. Additionally, high business risks may partly explain why capital stocks of MSEs remain low. This article analyzes the determinants of capital stocks of MSEs in poor economies focusing on credit constraints and risk. The analysis is based on a unique, albeit cross-sectional but backward-looking, micro data set on MSEs covering the economic capitals of seven West-African countries. The main result is that capital market imperfections indeed seem to explain an important part of the variation in capital stocks in the early lifetime of MSEs. Furthermore, the analyses show that risk plays a key role for capital accumulation. Risk-averse individuals seem to adjust their initially low capital stocks upwards when enterprises grow older. MSEs in risky activities owned by wealthy individuals even seem to over-invest when they start their business and adjust capital stocks downwards subsequently. As other firms simultaneously suffer from capital shortages, such behavior may imply large inefficiencies.

Keywords: Micro and small enterprises, credit constraints, risk, risk aversion, firm growth, West Africa.

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1. Introduction

Recent studies have consistently found very high marginal returns to capital in small-scale non-agricultural businesses in poor countries (Udry and Anagol, 2006; McKenzie and Woodruff, 2006, 2008; De Mel *et al*., 2008; Fafchamps *et al*., 2011). This may sound surprising to those who have viewed at least a large portion of these activities as an urban subsistence sector, but less surprising to those who are aware of the very high interest rates being charged even by micro-credit institutions. Such rates can only be paid if high marginal returns can be earned from small-scale activities. These high marginal returns, often in excess of prevailing market interest rates, may mirror the fact that micro and small enterprises (MSEs) are severely credit-constrained. Were their owners to have access to credit or have wealth that can be tapped they would invest additional capital until their marginal returns equal market interest rates. Without this access and no own resources, they are stuck with low levels of capital and high marginal returns. Alternatively, marginal returns may be high on average, but are at the same time very risky. Risk-averse individuals will then invest less capital into risky activities and again wealth will play an important role, as it influences the entrepreneur's willingness to take risks. The lack of insurance markets to insure non-business risks may also cause households to hold precautionary savings. Such a mechanism does not only illustrate the possible interactions between risk and credit constraints. It would explain why entrepreneurs do not re-invest earnings despite high marginal returns.[1]

Most evidence on the effects of risk and credit constraints on MSEs comes from advanced economies (e.g. Binks and Ennew, 1996; Carpenter and Petersen, 2002)[2] and while there is ample evidence on capital market failures in developing countries, including some evidence on firm growth (Banerjee and Munshi, 2004; Hutchinson and Xavier, 2006; Guariglia *et al*., 2011), the effect of risk on firm growth and capital accumulation remains less well investigated empirically. This study makes an attempt to fill this gap using a unique, albeit cross-sectional but backward-looking, micro dataset on informal enterprises covering the economic capitals of seven West-African countries. We do so by examining the determinants of capital stocks in small-scale activities using both non-parametric and parametric approaches. The so-called 1-2-3 surveys used in our analyses provide capital stocks of individual activities – as opposed to household-level information found in most standard large-scale surveys – and a wealth of information on entrepreneurs and households that we can use to construct proxies for capital constraints and risk. In particular with regard to risk, the differences across countries offer an interesting additional source of variation.

[1] Another explanation might be that entrepreneurs in such poor contexts have very high time preference rates. Furthermore, low re-investment rates may be caused by savings constraints due to the lack of savings institutions or knowledge on how such institutions function.

[2] This also reflects a "scholarly disconnect" between development economics and entrepreneurship research (Audretsch *et al*., 2007; Naudé, 2010).

The study departs from earlier work on the same dataset that identified, similar to other studies, very high returns to capital, in particular at low levels of capital (Grimm *et al*., 2011). While the present study does not attempt to explicitly link returns, capital stocks, and constraints, it does provide indirect evidence on the causes of high returns by explaining why so many MSEs have very low capital stocks. The main result is that capital constraints seem to explain an important part of the variation in capital stocks in the early lifetime of MSEs. We find some evidence that credit-constrained firms on average accumulate capital when they become older. The importance of credit constraints is in line with earlier findings, but our analysis suggests that risk is likely to play an equally if not more important role in explaining capital stocks of MSEs – again mainly in the early lifetime of an MSE. We find that firms without credit-constraints even reduce their (average) capital stocks in risky environments when they grow older. Such behavior potentially signals large aggregate efficiency losses.

The remainder of the paper is organized as follows. Before we review previous evidence, we develop a simple theoretical model of a firm's decisions under credit market constraints and risk. The following sections present our empirical analyses. The final section concludes.

2. Risk and capital market imperfections: Theoretical considerations

Capital market constraints are discussed in many papers on the informal sector, although often rather implicitly. Some authors hypothesize that the informal sector can be divided into different segments characterized by different entry barriers in terms of skill or capital requirements (Fields, 1990; Cunningham and Maloney, 2001). Fields (1990), for example, distinguishes between a lower and an upper tier of the informal sector. The lower tier would be characterized by low levels of capital and low returns to labor, while entrepreneurs in the upper tier would have been able to overcome entry barriers, for example in form of a minimum required investment in physical capital.

Such fixed costs should only cause segmentation when capital markets do not function properly. Accordingly, incomplete capital markets have long been stressed as a major economic constraint to entrepreneurial activity in developing countries (e.g. Tybout, 1983; Bigsten *et al*., 2003, Banerjee and Munshi, 2004; Guariglia *et al*., 2011). Information asymmetries and moral hazard that cause capital market failure are typically exacerbated in developing economies and more so for MSEs. Informal entrepreneurs with a different capacity to provide collateral may therefore face different costs of capital, which in turn causes some entrepreneurs to operate with sub-optimal levels of capital. Alternatively, the capital-constrained entrepreneur may choose (or rather be forced) to invest in different technologies (Banerjee and Duflo, 2005). Hence, in the presence of capital constraints, capital does not flow to its most productive uses.

Risk is the second fundamental force that affects investment, capital stocks, and returns to capital of MSEs. Similar to capital constraints, risk drives a wedge between market interest rates and marginal returns, as risk-averse entrepreneurs demand a risk premium on their

invested capital stock. What differs here between entrepreneurs, however, is not the capital cost that they face, but the shadow value that they attach to marginal risky profits. Compared to risk-neutral entrepreneurs, this shadow value will be lower for a given investment. Risk-averse individuals will invest less into risky entrepreneurial activities. MSE activities that operate with low levels of capital are likely to be highly vulnerable to shocks. Accordingly, most MSE activities are short-lived[3] and entrepreneurs move in and out of business. Fafchamps (1999) notes that, in such a risky environment without appropriate contract-enforcing formal institutions, "true" business risk is likely to be compounded by opportunistic and contractual risk. The argument is that high exposure to risk makes it easy to falsely claim inability to comply with contractual obligations towards a business counterpart. Entrepreneurs can use various strategies to deal with the risks associated with their business activities, including diversification and precautionary savings. We try to incorporate this possibility in a very simple way in the following small formal model of the decisions of an informal entrepreneur.

Our small model shows how the lack of access to capital as well as risk and risk aversion alter the behavior of a profit-maximizing 'self-employed' entrepreneur. We assume that the entrepreneur derives utility from consumption *c,* where *c* is the sum of profits π from a risky MSE activity and *sD*, a safe return from an asset *D*. Profit π can be expressed as the difference between sales *py* and the cost of capital *rK*, the only input used by the entrepreneur in our model. As in Sandmo (1971), let *p* be a random variable with expected value one and positive support, while *s* is non-random. Furthermore, let the market interest rate *r* be higher than the rate of return from the safe asset, i.e. $r > s$.

$$U(c) = U(\pi + sD) = U\big((py - rK) + sD\big) \tag{1}$$

In such a setting, a rational entrepreneur maximizes the expected utility of profit (using technology *f* to produce *y*) and safe asset returns. Capital *K* can be financed from external sources *B* and from internal wealth *W*. Investment in the safe activity *D* reduces the resources available for investment in *K*. Since $r > s$, the entrepreneur will never want to obtain credit for the safe asset.

$$\begin{aligned} &\operatorname{Max} E\big(U(c)\big) \\ &\text{s.t.} \\ &K \le W + B - D, \\ &K, D \ge 0. \end{aligned} \tag{2}$$

This gives the following Lagrange function

$$L = E\big(U(py - rK + sD)\big) + \lambda_1\big(W + B - D - K\big) \tag{3}$$

and the subsequent first-order conditions (FOCs) for the maximization of expected utility are

[3] This also holds for the activities in our dataset, as we will show below.

$$\frac{\partial L}{\partial K} = f'(K)E\left(U'(c)\,p\right) - rE\left(U'(c)\right) - \lambda_1 = 0$$
$$\Rightarrow f'(K) = \frac{rE\left(U'(c)\right) + \lambda_1}{E\left(p \cdot U'(c)\right)} = \frac{E\left(U'(c)\right)}{E\left(p \cdot U'(c)\right)}\left(r + \frac{\lambda_1}{E\left(U'(c)\right)}\right) \tag{3.1}$$

and

$$\frac{\partial L}{\partial D} = sE\left(U'(c)\right) - \lambda_1 = 0 \Rightarrow \lambda_1 = sE\left(U'(c)\right) \tag{3.2}$$

.

Note that

$$E\left(p \cdot U'(c)\right) = Cov\left(U'(c), p\right) + E\left(p\right) \cdot E\left(U'(c)\right).$$

Then, (3.1) can be written as

$$f'\left(K\right) = \frac{1}{E\left(p\right)\left(1 + \frac{Cov\left(U'(c), p\right)}{E\left(U'(c)\right)}\right)}\left(r + \frac{\lambda_1}{E\left(U'(c)\right)}\right) \tag{3.3}$$

.

Note that the covariance is negative for a risk-averse entrepreneur; there is hence a marginal cost of risk $-\frac{Cov\left(U'(c), p\right)}{E\left(U'(c)\right)}$.

First, we consider perfect capital markets, but maintain the assumptions of risk associated with prices and risk aversion on part of the entrepreneur. In order to reduce exposure to risk, i.e. to reduce the variance of profits, the entrepreneur can simply scale back output by using less capital. This is the typical trade-off between risk and expected profit, which is illustrated by the first-order condition that with complete capital markets reduces to

$$f'(K) = \left(\frac{E\left(U'(c)\right)}{E\left(p \cdot U'(c)\right)}\right) \cdot r\,. \tag{4}$$

Note that $Cov\left(U'(c), p\right) = E\left(p \cdot U'(c)\right) - E\left(p\right) \cdot E\left(U'(c)\right)$ and since the covariance is negative for a risk-averse entrepreneur (the higher the price, the smaller the marginal utility of consumption) and $E\left(p\right)$ is assumed to be unity, we have

$$E\left(p \cdot U'(c)\right) - E\left(U'(c)\right) < 0 \Leftrightarrow E\left(U'(c)\right) / E\left(p \cdot U'(c)\right) > 1.$$

Thus, if profits are uncertain and the entrepreneur is risk-averse, marginal returns will be higher than the market interest rate. The difference will be more pronounced the higher the price risk and the more risk-averse the entrepreneur.[4] So will be the difference in terms of capital employed. Note also that the capital employed by wealthier individuals will be higher if $U''(c) < 0$, as typically assumed. This is because wealthier individuals with higher levels of *c* will then be less risk-averse.

[4] To see this, write $Cov\left(U'(\pi), p\right)$ as $Corr\left(U'(\pi), p\right) \cdot \sqrt{Var(U'(\pi))} \cdot \sqrt{Var(p)}$.

Second, we consider the case when only credit market constraints are binding. If either p is a constant (no risk) or $U'(c)$ is a constant (no risk-aversion), the covariance is zero and since $E(p)$ is unity we have:

$$f'(K)=\left(r+\frac{\lambda_1}{E(U'(c))}\right)=(r+s) \quad . \tag{5}$$

The entrepreneur would then wish to invest more than his access to external or own sources of capital allow for. The marginal product of capital will then be higher than the market interest rate reflecting the sub-optimal capital stock. As we have assumed *r > s,* the entrepreneur will therefore invest his entire wealth into his enterprise in the absence of risk. The capital stock is in this case only determined by the capital constraint, i.e. the entrepreneur's wealth level, *K=W*.

Third, we take into account the safe asset and look at both capital constraint and risk simultaneously. Remember that the FOC for *D* is $\lambda_1 = sE(U'(c))$. If λ_1 is not binding, the entrepreneur will always invest his entire wealth into the safe return activity and then choose his optimal capital stock according to equation (4) using external finance. More interesting is the case when λ_1 is binding and risk plays a role. Then, the entrepreneur will choose a portfolio between the safe returns from asset *D* and unsafe MSE profits. The condition for this portfolio is

$$f'(K)=\left(\frac{E(U'(c))}{E(p\cdot U'(c))}\right)\left(r+\frac{sE(U'(c))-\lambda_1}{E(U'(c))}\right)=\left(\frac{E(U'(c))}{E(p\cdot U'(c))}\right)\left(r+\frac{\lambda_1}{E(U'(c))}\right)$$
$$=\left(\frac{E(U'(c))}{E(p\cdot U'(c))}\right)(r+s) \tag{6}$$

The allocation in this portfolio will now be determined according to equation (6). The higher s, the return to the safe asset, the higher the difference between r and $f'(K)$, i.e. the lower will be the capital stock. Furthermore, equation (6) illustrates that the opportunity cost of a binding capital constraint will be lower for a (more) risk-averse or less wealthy entrepreneur, as he attaches less value to foregone risky profits. In other words, if entrepreneurs are capital-constrained, risk associated with the entrepreneurial activity has to be dealt with by the entrepreneur through trading low safe returns against higher returns from risky activities. The consequence is that risk aversion will negatively affect the capital stock of capital-constrained entrepreneurs.[5] To sum up the main results of the model: Credit constraints may hinder some entrepreneurs from investing optimally and these constraints can possibly be overcome by access to own resources or wealth. Sub-optimal capital stocks can also be due to risk aversion and risk, albeit wealth may again cushion this effect, as more

[5] In an even simpler model without the possibility of safe investment, there will be no effect of risk on the capital stock, as the latter will just result from a binding credit market constraint, as for example in De Mel *et al*. (2008).

wealthy entrepreneurs are likely to be less risk-averse. Finally, risk and credit constraints may also interact. First, the effect of risk depends on whether the credit constraint is binding or not. Second, credit-constrained entrepreneurs have to allocate limited resources to activities with different degrees of risk.

Theoretical results similar to ours can be derived in a slightly different setting. In their model of investment behavior of poor rural farmers, Fafchamps and Pender (1997) and Fafchamps (1999) suggest integrating the theory of precautionary saving with that of capital constraints and irreversible investment under risk. Their starting point is that risk aversion implies a motive for precautionary saving and hence prospective investors require a liquidity premium, that is, a level of precautionary savings deemed comfortable enough for the investment to take place. The authors then show that the liquidity premium acts as a deterrent to investment because the agent must accumulate not only the cost of the investment itself but also the amount of liquid wealth he/she wishes to hold. Obviously, a low return on liquid wealth reinforces the disincentive effect on an agent's willingness to accumulate.[6]

We think of this static model to represent the optimal "steady state" capital stock that we denote K^* in the following. K^* will be lower for more risk-averse individuals and in riskier activities. This will also be the case for credit-constrained individuals who prefer safe consumption over risky profits. In general, of course, credit constraints reduce the steady state capital stock.

$$K^* = K\left(\overset{(-)}{Risk}, \overset{(-)}{RiskAv}, \overset{(+)}{W} \right) \tag{7}$$

Yet, most enterprises will not (yet) have reached this optimal level and both risk and credit constraints influence the pattern of capital accumulation. We therefore develop below a reduced-form model of capital accumulation, i.e. when investment is seen as the result of a dynamic decision process. We refrain from a full dynamic representation here since our dataset is cross-sectional with only current capital stocks, which nevertheless are the result of a dynamic process. In a risky world with credit constraints, the current level of capital stock can be thought of as a function *g* of the optimal "steady state" capital, profits, the age of the enterprise, and wealth.

$$K = g\left[K^*\left(Risk, RiskAv, W \right), MSEage, \pi(Risk), Risk, RiskAv, W \right] \tag{8}$$

The first dynamic extension incorporated into equation (6) is the possibility to overcome capital constraints by retaining earnings (Evans and Jovanovich, 1989; Cabral and Mata, 2003). This strategy should allow capital constrained entrepreneurs to accumulate capital, particularly if marginal returns at low levels of capital are high. Capital stock would then be increasing with MSE age (*MSEage*) and it should increase faster if profits are high. Ceteris

[6] A similar result can be obtained in an intertemporal decision model with inadequate access to consumption credit (or insufficient wealth to smooth consumption). See Eswaran and Kotwal (1990).

paribus, expected profits are higher in risky activities. This implies that – conditional on enterprise age – a credit constrained enterprise in riskier activities on its way to a (lower) steady state capital stock might exhibit higher capital stocks during the process of accumulation than an entrepreneur in less-risky activities. As the steady state capital stock in risky activities is lower, the "net" effect of risk is then ambiguous and should depend on the age of the enterprise.

A second extension considers the option value of postponing a partially or totally irreversible investment when more information on investment profitability becomes available through time (Dixit and Pindyck, 1994).[7] The resulting value of waiting would lead to a stepwise approximation to the optimal level of capital stock (Jovanovic, 1982).[8] The value of waiting will be higher – and capital will be accumulated more slowly – the more risky the activity and the more risk-averse the entrepreneur. A similar stepwise pattern of accumulation could simply result from reduced risk when an entrepreneur learns about his business risks and how to deal with them in the course of time. These considerations hence imply again that the capital stock would be positively correlated with MSE age. In addition, both risk and risk aversion would reduce the capital stock along the transition path to the steady state capital stock. Finally, wealth is likely to accelerate this transition due to relieving credit constraints and mitigating possible effects of risk. We summarize the signs of the expected gross and net effects in equation (9).

$$\begin{aligned} K &= g\left[K^{*}\left(\overset{(-)}{Risk}, \overset{(-)}{RiskAv}, \overset{(+)}{W} \right), \overset{(+)}{MSEage}, \pi\left(\overset{(+)}{Risk} \right), \overset{(-)}{Risk}, \overset{(-)}{RiskAv}, \overset{(+)}{W} \right] \\ &= g\left[\overset{(+)}{MSEage}, \overset{(-/+)}{Risk}, \overset{(-)}{RiskAv}, \overset{(+)}{W} \right] \end{aligned} \tag{9}$$

3. Previous evidence

The above model demonstrates how credit constraints and risk can lead to a sub-optimal capital stock employed in a typical MSE. The direct implication of low capital stocks is that small-scale activities exhibit high marginal returns. This should be particularly true whenever small-scale entrepreneurs find themselves close to the origin of a neoclassical production function. And indeed, recent rigorous studies, partly relying on experimental methods, suggest that in many developing countries returns at low levels of capital or in small-scale activities are relatively high. Furthermore, most of these studies hint at capital constraints as a likely cause of these high returns, while there is less evidence on the role of risk.

High returns in small-scale activities have for instance been shown by De Mel et al. (2008) who use data from a randomized experiment to estimate returns to capital of Sri Lankan microenterprises. In this experiment, the authors randomly provide cash or in-kind transfers to microenterprises. They use the random treatment as an instrument for changes in the

[7] Partial irreversibility is likely to be of more relevance in the context of urban MSEs.

[8] Fafchamps (1999) shows this option value can be positive even without additional information if agents are credit-constrained, i.e. there is a value of using own resources for consumption smoothing.

capital stock and find marginal returns to capital in a range from 55 to 70 percent per year. In a similar experiment with small-scale retailers in Mexico, McKenzie and Woodruff (2008) find even higher returns (20 to 33 percent marginal return per month). Non-experimental studies come to similar conclusions. McKenzie and Woodruff (2006) estimate returns to capital for microenterprises in Mexico using data from Mexico's National Survey of Micro Enterprises (ENAMIN). The authors find very high returns of 20 percent per month at low levels of capital – albeit somewhat lower than their later experimental estimates. At capital levels of 400 to 800 USD these returns fall to five percent (per month). Using policy changes in a directed lending program as a natural experiment Banerjee and Duflo (2004) estimate returns to capital of about 80 percent (annually) for small- and medium-sized firms in India.

For Sub-Saharan Africa, similar evidence is provided by a number of recent studies. Using an experimental approach – similar to the above studies – Fafchamps et al. (2011) confirm earlier results of high returns at low levels of capital for the case of Ghana. Udry and Anagol (2006) analyze both agricultural and non-agricultural investment in Ghana. The authors find returns to investment in a new technology of pineapple cultivation to be extremely high, up to 250 percent annually and still up to 30 to 50 percent in traditional food crop cultivation. Udry and Anagol (2006) concede that their estimates may only be taken as an upper limit of the returns to capital, as it is not possible to distinguish between returns to capital and returns to entrepreneurship. In order to estimate a lower bound for returns to capital the authors use data on pairs of durable goods (more specifically, fan blade motors for taxis) that are equal in all respects but the life expectancy. Assuming that only the differences in the expected usage period of the goods, i.e. higher opportunity costs of capital, explain price differences the authors compute returns to capital of 60 percent. The latter findings are in line with Kremer *et al*. (2010) who use data from small retail firms in rural Kenya that report stock-outs of cell-phone top-up cards. From these stock-outs Kremer *et al.* (2010) compute lost sales of such cards due to insufficient inventory. By measuring daily stock-outs the authors are able to measure the probability that an additional phone card would have been sold in a given time period, had the shop-owner bought it at the beginning of the period. Thus they can estimate marginal rates of return to inventory investment by calculating the expected marginal benefit from holding an additional unit and comparing this to the marginal cost of obtaining an additional unit. They find that the average shop in the sample could achieve an (annual) return of 113 percent to a marginal increase in inventory (the median shop achieves 36 percent). An alternative approach based on administrative data on whether firms purchased enough to take advantage of quantity discounts from wholesalers result in an estimate of similar magnitude. With the same dataset used in this paper, Grimm *et al.* (2011) find extremely high marginal returns to capital at low levels of capital (in some sectors and countries exceeding 100 percent per month). Similar to McKenzie and Woodruff (2006), they detect very heterogeneous patterns of capital returns in informal MSEs. While very high at very low levels of capital, marginal returns decrease rapidly. In a medium range of capital between 150 and 1,000 international dollars, marginal returns tend to be close to zero. Only at higher levels of capital, significant positive returns of about 6 percent marginal monthly return can be earned.

Most of these studies either explicitly or implicitly address the causes of these high returns. A number of the above studies provide direct evidence that the observed high returns are caused by credit constraints. In their experimental studies, McKenzie and Woodruff (2008) and De Mel *et al.* (2008) analyze heterogeneity in treatment effects. Both studies examine whether marginal returns differ between microenterprises that are more or less credit-constrained. They interact the treatment amount with proxies of constraints (number of wage workers and wealth of the household in the Sri Lankan case and indicators of credit history and perception of being credit-constrained in the Mexican case). Consistent with credit market constraints, the studies find treatment effects, i.e. marginal returns to capital, to be higher for constrained entrepreneurs. In the Sri Lankan case, De Mel *et al.* (2008) also look at risk and risk aversion (measured by the subjective perception of variation in profits and results from lottery experiments). However, they cannot detect significant differences in marginal returns between risk-averse and less risk-averse entrepreneurs. Risk does not even have the expected positive effect: If anything, they can find a negative risk premium, i.e. marginal returns are lower for those who report higher profit variation. From these findings, De Mel *et al.* (2008) conclude that the high marginal returns found for Sri Lankan microenterprises are likely to be caused by credit constraints rather than insurance market failure.

Banerjee and Duflo (2004) rely on a natural experiment that is given by a change in a lending program. The authors assume that credit-constrained firms will use additionally available funds for expansion while unconstrained firms will substitute other borrowing with this cheaper source of credit. Their results suggest that some firms are indeed severely credit-constrained. In their non-experimental study on Mexican microenterprises, McKenzie and Woodruff (2006) provide suggestive evidence for the existence of capital constraints. They show that asset-poor households are more likely to have MSEs with low levels of capital stock (and high marginal returns). Not surprisingly, asset-poor households are completely excluded from access to formal credit, which implies that they have to turn to moneylenders who charge extremely high borrowing rates. The authors also test whether MSEs acquire more capital as they learn about the profitability of investment by looking at the share of new entrants at different levels of capital. Unlike their expectation, they find younger firms to have higher capital stocks. Additionally, McKenzie and Woodruff (2006) analyze the role of risk by examining the variability of earnings at different levels of capital stock. Their results suggest that entrepreneurs with lower levels of capital do not face higher risks in terms of earnings variability (measured by the coefficient of variation in earnings). Grimm *et al.* (2011) are also not able to show that such indicators of risk would be higher for firms with low levels of capital stock (and high returns). While descriptive statistics indicate that MSEs with low levels of capital stock are likely to be severely capital constrained, access to capital does not seem to be different enough from other MSEs to explain the extreme differences in returns across the capital stock distribution. The authors suggest that risk should therefore explain the extremely high returns at low levels of capital. Udry and Anagol (2006) argue similarly that high returns to pineapple cultivation may be partly explained by the unobserved returns to taking entrepreneurial risk of a new technology.

That credit markets do not function properly can also be inferred from the great variance of returns that is found in almost all the studies cited above. If returns vary greatly across firms there is a large potential to increase efficiency by reallocating capital across firms, a function that should be fulfilled by capital markets. That this does not necessarily happen in developing countries is nicely illustrated by Banerjee and Munshi (2004) using a case study of the knitted garment industry in Tirupur in Southern India. They find large and systematic differences in both levels of capital stock and the capital intensity of production in firms owned by people from two different communities. The authors show that these differences are likely to be due to differences in access to capital between these two groups. One of these groups, the Gounders, from a relatively wealthy agricultural community, was the first to move into the garment industry in Tirupur. Banerjee and Munshi (2004) find that they start their businesses with much higher levels of capital stock than comparable outsiders. They argue that this is because of their stronger ties to the local community and the associated better access to finance. Both groups accumulate capital over time, but the outsiders do so much faster to catch up with the Gounders after approximately seven years. In addition, capital stocks do not significantly differ at this stage despite the fact that the Gounders are found to be less productive than their counterparts. Instead of comparing groups within the same economic context, Hutchinson and Xavier (2006) compare micro, small and medium enterprises from two countries at different stages of development: Slovenia, a transition economy, and Belgium, a more advanced economy. They find that firms in Slovenia have difficulties in accessing external finance and that firm growth therefore depends on the availability of internal funds.[9]

A related literature examines the dynamics of MSEs (Mead and Liedholm, 1998; Faijnzilber *et al.*, 2006) more generally. Mead and Liedholm (1998) summarize the findings of a research project on MSE dynamics, which draws (partly) on panel datasets of MSEs from a number of developing countries. The authors typically find high rates of churning among MSEs, with survival being positively associated with firm age, smaller initial size and past growth. The analysis of firm growth shows that MSEs that were smaller at start-up tend to grow more rapidly than their larger counterparts; younger firms also grow faster. These results are similar to those obtained by Faijnzilber *et al.* (2006) using (again) the Mexican ENAMIN data. They conclude that microenterprises in Mexico show dynamic patterns consistent with a number of standard results from the theoretical literature on firm dynamics. This general view is confirmed by a comparison between Mexican and American microenterprises that shows remarkable similarities of self-employment in these two countries. While these two studies do a good job in describing some dynamic features of MSEs in developing countries, they have little to say on the causes of differences in behavior. Faijnzilber *et al.* (2006) do present some suggestive evidence in favor of credit constraints[10] causing some of the

[9] Similar results are provided by Sarno (2005) who compares firms from Northern Italy with firms from the lagging South where liquidity constraints also appear to be much more binding.

[10] They regress employment growth on dummies for credit at start-up and dummies for subsequent credit (and a set of other controls). They find lower subsequent growth for firms with start-up credit – as these firms reach their optimal capital stocks more rapidly – and higher growth for those with subsequent access to credit – as these firms can more quickly adjust to their optimal levels.

observed patterns. Yet they concede that the possibility of simultaneity renders a causal interpretation of their findings speculative.

In sum, there is evidence for massive capital market failure in low and middle income countries. The capital market does neither supply enough credit nor is capital efficiently allocated across firms of small size. This should partly explain the high returns in small scale activities that are consistently found in the studies that we have reviewed. However, capital market failure alone is unlikely to explain the observed pattern of returns. There should therefore be an important role for risk, but empirical studies seem to have difficulties in establishing a causal link between low levels of capital and the related high returns, on the one hand, and risk, on the other.

To put some of the above empirical findings into perspective, it is important to note that high marginal returns at low levels of capital have two facets. On the one hand, high marginal returns may simply mirror the fact that capital stocks are low and that the average (representative) entrepreneur produces with a production function with the typical properties. Then, high returns can be rationalized by either credit constraints or risks that cause capital stocks to be low. On the other hand, returns may be higher for credit-constrained entrepreneurs for a given level of capital. Then, enterprises are heterogeneous in terms of productivity – a possibility precluded in the above model and only implicitly considered in some of the reviewed empirical studies. In this world with heterogeneous firms, non-exploited productivity differentials between firms due to capital market frictions may partially explain high marginal returns at low levels of capital stocks.

It is instructive to think about this in terms of the above experiments by McKenzie and Woodruff (2008) and De Mel *et al.* (2008). If homogeneous firms are credit-constrained and therefore operate with low levels of capital close to the origin of a neoclassical production function the average treatment effect of a capital injection will be high. In this case, when firms operate with the same technology, differences in access to credit cause differences in capital stocks, which in turn are reflected in differences in marginal returns – very similar to what we illustrate with the above model. Treatment effects of a capital injection will differ between firms with different access to capital and hence different levels of capital stock. Yet, for a given level of capital, the treatment effect will be the same for all firms. This will not be the case if firms differ in productivity. Then, the treatment effect can differ between firms for a given level of capital. Capital returns, which have been the focus of the recent empirical literature, hence reflect the joint outcome of productivity differences and credit constraints. If credit constraints are more likely to be binding for more productive firms with possibly higher optimal levels of capital stock, the treatment effect of a capital injection will then be higher for credit constraints firms.[11]

This needs to be taken into account when enterprise performance – and the role of credit constraints and risk – is analyzed by looking at capital returns. In a cross-section, a possible empirical approach would estimate a production function and interact capital with a proxy for the respective constraint with the expectation that marginal returns to capital would be

[11] A similar argument can be constructed for risk.

higher for credit constrained firms or firms in risky activities. Yet, such an effect is conditioned on the capital stock and, as just explained, could only be observed if the constrained firm is more productive. For our cross-sectional sample of MSEs, there is evidence that the differences in returns between constrained and unconstrained firms for a given level of capital are less pronounced.[12] Firms hence appear to move along a fairly homogeneous production function – at least with regard to capital-output elasticities. This finding provides a rationale for directly examining the determinants of capital stocks. Such an analysis allows for assessing the impact of credit constraints as well as risk and risk aversion on capital accumulation and hence to reveal the causes of the high marginal returns to capital in MSEs observed in previous studies.

4. Data and some basic MSE characteristics

Our analysis relies on data that stem from a set of surveys called 1-2-3 surveys (Enquêtes 1-2-3) in seven economic capitals of the West-African Economic and Monetary Union (WAEMU) in the early 2000s.[13] A 1-2-3 survey is a multi-layer survey organised in three phases and specially designed to study the informal sector.[14] Phase 1 is a representative labor force survey collecting detailed information on individual socio-demographic characteristics and employment. Phase 2 is a survey which interviews a representative sub-sample of informal production units identified in Phase 1. The focus of the second phase is on the characteristics of the entrepreneurs and their production unit, including the characteristics of employed workers. It also contains detailed information on input use, investment, sales, profits and the unit's forward and backward linkages. Phase 3 is a household expenditure survey interviewing (again) a representative sub-sample of Phase 1. The data of all three phases is organized in a way so that it can be linked. For this paper we mainly use data from Phase 2, i.e. a sample of informal entrepreneurs in seven West-African urban centres.

The 1-2-3 surveys define informal enterprises as production units that are not registered with the tax administration.[15] This definition varies slightly between countries, as registration may not always refer to registration with tax authorities. These production units

[12] Production function estimates with profits (defined as value added – sales minus input costs – minus expenses for hired labor) as dependent variable indicate that the coefficient of log capital in a log-log specification does not differ between constrained and unconstrained firms (estimates not reported, but available from the authors). More specifically, the interaction of a proxy of credit constraints (that we will explain in detail below) with log capital does not turn out to be significant. For a risk index (again detailed below) we obtain similar results. Albeit the interaction with log capital is negative and significant, the effect is very small.

[13] These urban centres are Abidjan, Bamako, Cotonou, Dakar, Niamey, Lomé and Ouagadougou. The surveys have been carried out by AFRISTAT with the support of DIAL as part of the Regional Program of Statistical Support for Multilateral Surveillance (PARSTAT) between 2001 and 2003. For a more detailed description of the data see Brilleau *et al*. (2005a, 2005b).

[14] See Roubaud (2008) for a detailed assessment of this type of survey instrument.

[15] An alternative criterion for classifying firms as formal is whether they have formal written accounts. However, all firms without formal written accounts are not registered with the tax authorities. Note that the registration criterion does not apply to simplified registration schemes geared towards informal sector firms.

are our unit of observation and they account for the vast majority of employment in the WAEMU cities covered by the surveys. The share of informal sector employment exceeds 70 percent in all cities considered – in Cotonou and Lomé even 80 percent. As can be seen in Table 1, employment in informal firms is typically self-employment, i.e. the employed individual is also the MSE owner, but employed and/or helping family- and non-family workers account for 30 to 40 percent of employment in this sector. The 1-2-3 surveys do not (explicitly) apply a size criterion, but more than 90 percent of the enterprises employ not more than three people including the owner and employed family members. The average firm size is 1.7 employees including the owner.

Albeit small, the enterprises in our sample had been in operation since almost eight years on average. The median age, however, is significantly lower with only five years. The age of the enterprise, which will be an important variable in the analysis below, stems from a question that asks the owner for the year when the enterprise was established. For more than 80 percent of the enterprises this is also the year when the current owner started operating the business.[16] Owners' experience in the business is typically lower than the MSE age, mainly reflecting that some MSEs are transferred within the family. MSE owners have only 3.6 years of schooling on average and about half of them are female. Average monthly profits of informal enterprises are about 90,000 CFA Francs (about 135 Euros or 385 International Dollar, Int. $) with median profits at only 25,000 CFA Francs (112 Int. $), i.e. close to 1 Euro a day.[17] Average capital stock is fairly high with about 1,000 Int. $, but this result is driven by a few MSEs with very high capital stocks – the median MSE capital endowment stands at only a fraction of the mean with 77 Int. $. Capital stocks are measured by the replacement value of all business-related assets, including the business establishment, machines, furniture, vehicles and utilities. More specifically, the entrepreneur is asked to report all the equipment that he owned in the last year for the purpose to operate his business and to provide the replacement value of each item.[18]

Insert Table 1 here

For a first assessment of MSE heterogeneity, we also report the above characteristics by capital quartiles (Table 2). The first quartile basically works without capital and these MSEs mainly comprise trading activities and other services (sectoral composition not reported). The profits of these enterprises are around 200 Int. $. Typically, these MSEs are self-employed individuals. This also holds for entrepreneurs in the second capital quartile. Their profits are about 15 percent higher than in the first quartile and on average their firms are one year older. In the third quartile, profits are more than 70 percent higher than in the second quartile while the average capital stock approximately quadruples. Yet, it remains low at only about 80 Int. $ on average. These MSEs have owners who still have below

[16] Unfortunately, we have no information on whether the operations of the enterprise have been interrupted at some point after its foundation.

[17] Profits are computed as value added (sales minus input costs including expenses for products for re-sale) minus expenses for hired labor.

[18] Grimm *et al.* (2011) show that using a different definition of capital stocks that includes also the value of inventories does hardly affect the estimates of capital returns.

average years of schooling, but 0.7 years more than those with very little capital. Fewer owners are female and their firms are slightly larger in terms of employment than those in the lowest quartile. From the second to the third quartile, changes are similar to moving from the first to the second. Capital stock again is five times higher, at 200 Int. $. Owners' average education increases and so does firm size and the share of male owners. However, monthly profits only increase by 70 Int. $ on average to 387 Int. $. Much more pronounced are the differences in capital and profits between the third and the fourth quartile. Average capital stock of MSEs in the fourth quartile is above 3,800 Int. $ and monthly profits are twice as high as in the third quartile.[19] These entrepreneurs also tend to be much better educated than the average and more than half of them employ at least a second person.

Insert Table 2 here

5. Constraints to informal entrepreneurs in Sub-Saharan Africa

In the subsequent empirical analysis, we examine the effects of economic constraints on capital accumulation using semi-parametric and parametric estimation techniques. Similar to Banerjee and Munshi (2004), we analyze capital stocks of MSEs as a non-parametric function of MSE age. As our data is cross-sectional, we hence construct "hypothetical accumulation paths by relating the observed current capital stock and the reported age of the MSE. This relationship is estimated for different groups that are defined using different sets of proxies for credit constraints as well as risk and risk aversion. As a robustness check, we also test the existence of such relationships using a parametric regression with interaction terms. With this simple approach, we should be able to demonstrate, for example, that credit-constrained entrepreneurs need time to accumulate capital from retained earnings, while their unconstrained counterparts will be able to immediately reach their optimal capital stock. In risky activities, (static) optimal capital stocks should be lower. Yet, as discussed above, entrepreneurs in risky activities may learn about the business-risks and approach their optimal capital stocks over time.

There are two major caveats with the approach we choose here. First, given that we have cross-sectional data, we do not observe exit of firms. Hence, with rising MSE age, our sample might be biased toward rather successful entrepreneurs, as less successful firms drop out of the sample. Since success should be reflected in a larger capital stock, such a selection effect may lead to higher average capital stocks with rising MSE age. This may thus overstate capital accumulation due to the reinvestment of profits. Second, enterprise age, one of the key explanatory variables in the below analyzes, does not only capture the effects of time in business, but also possible cohort effects. This may be a severe problem and may bias the effects of enterprise age, for example if firm cohorts have experienced systematically

[19] These figures imply that capital profitability is high at low levels of capital and declines fairly quickly at higher levels. This pattern explains why Grimm *et al.* (2011) find high marginal returns to capital at low levels of capital.

improving start-up conditions with persistent effects on capital accumulation. Such biases are difficult to rule out if we are set to recover the relationship between current capital stocks and enterprise age, but having data from seven different countries mitigates the problem somewhat. We will come back to both exit and cohort effect biases when we discuss our empirical results below.

Keeping this in mind we turn now to Table 3 which provides an age profile of MSEs according to their current level of capital stock. In contrast to the findings by McKenzie and Woodruff (2006) for Mexican MSEs, our dataset partly shows the expected pattern of a positive correlation between capital stock and MSE age.[20] Among MSEs with low levels of capital, more very young firms (aged less than 2 years) can be found than at higher levels of capital. Accordingly, old MSEs are less likely to have very low levels of capital. However, the pattern is not unambiguous. Firms older than eight years quite often exhibit intermediate levels of capital rather than high levels. These patterns may still be taken as a first indication that firms are indeed credit-constrained or that there are processes of learning by experience.

Insert Table 3 here

5.1 Credit market imperfections

The main hypothesis to be tested in the following is whether credit-constrained MSEs accumulate capital while getting older, while MSEs with access to credit or other sources of finance reach their optimal levels of capital stock more quickly. In addition we should be able to say something on the speed of adjustments. For the subsequent semi-parametric analyses, we reduce our sample to MSEs aged 12 years or less, as the number of observations of higher age becomes too small (and the variance of our age-specific estimators too large). In addition, we drop MSEs who report no capital and those from households with more than one MSE, as capital may be accumulated by establishing new MSE units. These operations that are necessary for semi-parametrically establishing the relationship between enterprise age and capital stock reduce our sample from 6,499 to 3,109 observations. This is of course a rather drastic reduction in sample size. Exploratory logit regressions of selection into this sample (not reported) suggest that the reduced sample has less female entrepreneurs with somewhat less schooling. As expected, manufacturing firms and relatively capital-intensive services (transport, repair services, hotels and restaurants) are more likely to be included. While our semi-parametric approach will be confined to this selective sample, we provide some robustness checks to sample selection in our parametric analyses below. Our approach requires us to split entrepreneurs into credit-constrained and unconstrained entrepreneurs and the dataset offers several different routes to do this. A first common route is to use household wealth as a proxy for access to financial resources (Evans and Jovanovic, 1989; Cabral and Mata, 2003). We derive a wealth index from principal component analysis based on household assets that are not

[20] McKenzie and Woodruff (2006) suggest that their findings may be due to older firms owning "more depreciated" capital stocks. Yet, they also find older firms to use less capital when they look at inventories, where this effect should not come into play.

related to the business. We then construct wealth quartiles and compare entrepreneurs from households in the first with those from households in the fourth wealth quartile. A second possibility to proxy for the lack of access to capital is information on the source of finance. For each investment undertaken by the entrepreneur, the survey provides the source of the financial means for the respective investment. This allows us to distinguish between access to family finance and access to all other kinds of sources of finance (i.e. loans from clients, loans from suppliers, loans from business associations, loans from informal money lenders, loans from micro-finance institutions and loans from formal banks). From this information we construct two dummy variables indicating whether the entrepreneur has financed any item out of his capital stock using the respective source. Table 4 illustrates that the share of entrepreneurs who state to have accessed these sources is fairly low. Only 4 percent claim to have access to family loans, which is not implausible. However, it is possible that finance from the family will typically not be declared and understood as a loan. This share rises with higher household wealth. Maybe somewhat surprisingly, this does not hold for sources of external finance, which on average are used by one out of ten MSEs. Here, participation is highest among firms from households in the lowest wealth quartile, suggesting that this typically concerns loans from informal money lenders.

A third route to identify credit-constrained firms is to rely on the subjective assessments by entrepreneurs, of which quite a few are requested in the survey. One question asks for the main difficulty threatening the existence of the entrepreneur's venture with the "lack of liquidity" as one of 12 possible answers (no multiple answers). The third column of Table 4 shows that 12 percent of all entrepreneurs find liquidity problems to be the major threat. Another similar question asks "Do you have problems or difficulties in the following areas?" where "Finance (difficulties to access credit)" and "Finance (credit too expensive)" are two of thirteen areas.[21] Almost 50 percent of the entrepreneurs state that credit is a problem and this share is somewhat lower for (asset-) rich entrepreneurs. About 30 percent find credit to be too expensive and this assessment does not differ much across wealth quartiles. Finally, the questionnaire also directly asks whether MSEs have ever obtained credit from a bank or a microcredit institution. The proportion of MSEs who have is very low (1 percent and 4 percent, respectively) and still lower for asset-poor entrepreneurs.[22]

[21] Respondents were allowed multiple answers to this question.

[22] There are several problems with subjective indicators. First, respondents might judge problems using different scales. Second and somewhat related, since respondents were only allowed to answer affirmative or negative, it is not clear how important a constraint lack of access to credit really is. Third, entrepreneurs might be motivated to "make up" problems if they think the survey is linked to some kind of assistance. For example, they might hope they will get access to cheap credit if they report problems. Fourth, entrepreneurs might be unable to obtain credit because they lack a solid business plan. In that case, reported problems might proxy for lack of entrepreneurial ability. However, Gelb *et al.* (2007) argue that perception data of this type is quite a useful and reliable source of information. Using a cross section of countries Gelb *et al.* (2007) compare aggregated self-reported constraints from the World Bank's Enterprise Surveys Database with more objective information such as GDP, average firm size and export status. The authors find a very high correlation between perceived constraints and the level of income across countries. Hence Gelb *et al.* (2007) argue in favor of using such information. These ambiguities are also apparent in Table 5 with the correlation matrix of all chosen credit

Insert Table 4 and 5 here

For the subsequent analyses of capital accumulation paths by credit-constrained and unconstrained groups, we use household wealth quartiles and a dummy variable for credit-constraints that we construct from several indicators from above. According to this proxy an entrepreneur is not credit-constrained if (1) he has financed some of his investment from family or external finance, or (2) has obtained a bank credit or microcredit at some point, or (3) belongs to the fourth wealth quartile. In the relevant sample, 66.1 percent of MSEs are credit-constrained according to this indicator.

Similar to Banerjee and Munshi (2004), we use a very simple approach to describe the capital accumulation paths of MSEs. We first regress log capital on full sets of sector and country dummies. The residual from this regression is then plotted against MSE age using local polynomial smoothing based on an Epanechnikov and a constant bandwidth of 3 years. When sub-samples, for example only the trade sector, are examined, the parametric regression of the first stage is run only on this sub-sample (excluding if necessary the irrelevant regressors, e.g. sector dummies). The results for different (sub-) samples using different proxies for capital constraints are presented graphically in Figure 1. We first examine the relationship between MSE age and capital stock for all MSEs (excluding some, as explained above) comparing MSEs from households in the first with those from the fourth wealth quartile (quartiles being defined only for the sub-sample using MSEs as units). Then, we look at groups categorized according to the dummy for being credit-constrained described just above.

Insert Figure 1 here

The main message from Figure 1 is that capital-constrained MSEs indeed accumulate capital over time, while non-constrained enterprises immediately reach their optimal capital stock (conditional on their country and sector). Graphs 1a and 1b of Figure 1 show accumulation paths for all MSEs. Graph 1a indicates that low wealth entrepreneurs have considerably lower initial capital stocks: The initial capital stock of entrepreneurs in the fourth quartile is about three times larger than the capital stock of those in the first quartile (differences in the log residual of approximately 1). While this gap closes somewhat in graph 1a, the gap narrows significantly when the all-MSE sample is split according the credit constraint dummy (Graph 1b). If we consider the trade sector only (Graphs 1c and 1d), the gap between constrained and unconstrained MSEs even becomes insignificant as MSEs grow older.

The results are robust to the inclusion of country and sector dummies in the regression (not reported). We come back to this point later when we discuss the results on risk where this is not the case. In addition, the results are robust to the inclusion of the entrepreneur's age (and squared age) into the parametric regression. If technologies exhibit complementarities between skills and capital and the entrepreneur's skills increase with age or experience this

constraint indicators. While most correlations between and among "objective" (wealth, access to finance) and subjective indicators have the expected sign, others, for example between "credit expensive" and a number of other indicators, are not significant.

might also explain an increase in capital.[23] However, because of the obvious correlation between MSE age and entrepreneur's age, the accumulation path of credit-constrained entrepreneurs becomes slightly less steep. The curves also flatten when we include cohort dummies, i.e. dummies for each age group, in the parametric regression in an attempt to control for cohort effects. Yet, even such an approach that is likely to control for an important part of the variation that we want to recover in the second non-parametric step, still produces a capital-age pattern that is qualitatively similar to those shown in Figure 1. Finally, it is reasonable to assume that ability is a positive correlate of MSE age as able entrepreneurs are less likely to exit the market. However, the above results are robust to including education and ability proxies in the first-stage regression. If we distinguish groups by the subjective indicators from above, i.e. liquidity constraints, credit as a problem, and credit too expensive, we cannot detect any difference between credit-constrained and unconstrained MSEs. We consider these findings as an indication of the limited explanatory power of such questions.

To this point, we have interpreted the increase in capital stocks of constrained MSEs as resulting from capital accumulation at the firm level. However, we cannot exclude the possibility that this result is at least partially due to selective firm mortality. If firms with sub-optimal capital are more likely to exit, the increase of capital with firm age – observed in the cross-section – could be driven by the mortality of firms with sub-optimal capital stocks at start. Then, all surviving firms of owners with low initial wealth may in fact have the same initial capital stocks than the high initial wealth firms. Yet, even if this is the case, firms of less wealthy entrepreneurs will be more likely to have sub-optimal capital stocks to begin with.

Not only may firms have left our sample because of firm death, they may also have become formal, i.e. registered with the tax authorities, and hence have dropped out of our sample of informal MSEs. To address this possible formalization bias it is instructive to look at the number of formal firms, as the data provide information on whether firms are classified as informal production units before the Phase 2 survey is administered to the informal MSE sample. While quite a number of firms does keep formal accounts (15.3 percent of the sample), only very few (3.4 percent) are registered with the tax authorities. Because of the survey's definition of informal production units, formalization bias would only arise if firms moved into the latter very small group of firms. Most firms, however, are likely to be far from becoming formal although we cannot fully exclude some bias to arise for results at higher capital stock and larger firm size.

5.2 Risk

In our analysis of the consequences of risk we rely on the same empirical framework used above, i.e. we examine accumulation paths of different groups of MSEs. We expect capital stocks to be lower in risky activities and/or for risk-averse entrepreneurs. Furthermore, the

[23] Exploratory regressions of profit functions (not reported) that include capital-education interactions do not indicate complementarities between skills and capital.

option value of postponed investment should lead risk-averse entrepreneurs to have lower levels of capital initially. With learning by doing and increasing information on the profitability of the business, they should adjust their capital stock upwards. The interactions between wealth (and credit constraints, respectively) and risk also have to be accounted for. More wealthy individuals may be more inclined to take business risks and hence require lower risk premia, i.e. ceteris paribus exhibit higher capital stocks than low wealth individuals that are not bound by a credit constraint. Finally, credit-constrained individuals will nevertheless have to trade safe consumption for unsafe profits using their asset endowments and therefore show more pronounced reactions to risk if they are risk-averse.

Not only are the theoretical expectations regarding the effects of risk and risk aversion on capital stock ambiguous with a multiplicity of possible interpretations; the empirical study of these effects is also complicated by a number of methodological issues. First, we do not have a perfect measure of risk aversion, which would ideally reflect attitudes towards entrepreneurial risk, for example based on experiments.[24] Second, risk itself cannot be easily measured although our study can also draw on the risk variation between countries while most other studies have to rely on inter-sectoral variation only (and possibly variation over time). Third, selection processes complicate the analysis. When more risk-averse individuals select themselves into low-risk but still risky activities, they will tend to invest less than individuals with average degrees of risk aversion who will be found in other activities. This effect will run against the main effect of lower risk in such an activity that, ceteris paribus, should lead us to observe higher capital stocks.

Although the survey does not perfectly operationalize risk and risk aversion, it offers a number of imperfect proxies for those concepts. First, it is of course possible to construct some "classical" proxies for risk as the variation of profits or sales. We measure this variation at the country-sector level, where sectors are disaggregated as finely as possible while keeping the number of observations in each country-sector cell at least at 30. Such a procedure yields 123 country-sector cells, for which we compute the coefficients of variation in profits and sales. Furthermore, we can use business risk perceptions of the entrepreneur to construct further proxies. As above, we use answers to the question "which is the major threat to the existence of the MSE" to construct dummy variables in a first step. We code a dummy variable "competition-as-major-threat" if the entrepreneur has answered either "the lack of clients" or "too much competition" (the answers to this question are exclusive). For any other answer the variable is coded zero. About 60 percent of the MSEs regard either competition or the lack of clients as a major business risk. A second dummy captures whether the entrepreneur is seeing his enterprise as being threatened at all. This "some-risk-of-closure" dummy is 0 if the entrepreneur sees no risk that his enterprise would close down and 1 if any of the other threats is being chosen. The latter holds for 90 percent, while only the remaining 10 percent of all MSEs report to be confident that they will survive.

[24] Such risk experiments have been conducted in rural contexts by Yesuf and Bluffstone (2009) and Tanaka et al. (2010).

While these perceptions of business risks are likely to include some notion of risk aversion, we think we get closest to risk aversion on the basis of a different question that asks for the motivation for taking up the specific business activity with one possible answer "assurance of more stable receipts than in other products". This holds for about 10 percent of the entrepreneurs (with the corresponding "chosen-because-of-stable-profits" dummy set to 1).[25]

Insert Tables 6 and 7 here

We report basic descriptive statistics of these proxies in Table 6 and the pairwise correlations (with significance levels) in Table 7. Most of these correlations are in line with expectations. Sales and profit variation, for example, are highly correlated. The pairwise correlations of these "objective" proxies with subjective ones, however, have the expected sign and are significant only for the sales variation. The pairwise correlations between the subjective proxies, in particular between the risk ("competition-as-major-threat" and "some-risk-of-closure") and the risk aversion proxy ("chosen-because-of-stable-profits"), have the expected signs and are in most cases significant.

From a combination of these proxies we also construct a risk proxy using principal components. More precisely, we use the country-sector coefficient of variation of sales, the competition-as-major-threat dummy as well as the some-risk-of-closure dummy (for both dummies we also include the corresponding country-sector averages) and the country-sector average of the "chosen because of stable-profits" dummy. The results of the principal components analysis are detailed in Table 8. The first principal component that we will use as risk proxy in the subsequent analysis explains about 30 percent of the "total variance" in the mentioned variables. This first component indeed appears to appropriately proxy risk, as the loadings associated to this first component all have the expected sign. The second component whose eigenvector is also shown in Table 8 seems to capture some notion of risk aversion. The loadings are negative for the country-sector proxies for risk (negative for the country-sector "chosen because of stable-profits" average) and higher for the idiosyncratic subjective variables. The latter result could be rationalized by risk-averse individuals judging their businesses more risky than less risk-averse individuals.[26] As this second component seems to reflect both risk aversion and risk, we prefer to use the "chosen because of stable-profits" dummy as an (admittedly imperfect) proxy for risk aversion and the first principal component as a measure of risk.

[25] The alternative answers to this question regarding the main motivation for taking up this specific activity are "family tradition", "expertise in this business", "higher profits than other businesses", and "others". For traditional family businesses, the proxy hence tells us little on the risk attitude of the owner. In the full sample, about 7 percent of the MSEs are motivated by family tradition. In the reduced sample used in the semi-parametric analysis, the share drops to about 5 percent, as enterprises that stem from a family tradition tend to be older. All the results below are robust to the exclusion of these enterprises from the sample. While we do find different patterns of accumulation in these traditional enterprises, these patterns do not seem to be related to risk and risk attitudes.

[26] We experimented with including the idiosyncratic risk aversion proxy into the principal components analysis and using the second component as a proxy for risk aversion. However, it seems that the second component still measures risk itself to a large extend. This is why we prefer the "chosen because of stable-profits" dummy over a proxy derived from principal components.

Insert Table 8 here

Before we turn to the accumulation paths by different groups, we want to briefly examine risk differences between different groups defined by capital stocks and wealth quintiles. Table 9 reports both the risk aversion proxy and the principal components risk index for these groups. Across wealth quartiles, the share of activities that have been chosen because they are expected to provide "stable profits" is only slightly lower for higher wealth quartiles, and even increases by 1 percentage point from the third to the fourth quartile. More pronounced are the differences between firms of different capital stock size with the share of "risk-averse" entrepreneurs being much higher (14 percent) in MSEs in the lowest capital stock quartile than in the higher quartiles (10, 7, and 8 percent). Risk-averse entrepreneurs may hence prefer low levels of capital stock – as predicted by the above theory. Yet, only among firms with low capital stock, there is an unambiguous relationship between wealth and the fact that the respective activity has been chosen because of stable profits. In the third capital quartile, more wealthy entrepreneurs even seem to be more risk-averse than their less wealthy counterparts; yet not so in the fourth capital quartile. There is hence some evidence that risk aversion is indeed related to wealth levels, but this relationship differs at different levels of capital stock. The means of the risk index that are also reported in Table 9 similarly show an interesting pattern that is, in principle, in line with expectations. The least risky activities are those with low levels of capital and risk is even lower at high levels of wealth in this groups. Generally, risk is higher at higher levels of capital and, in the highest capital quartile, we clearly see that wealthy individuals are more likely to engage in risky activities.[27]

Insert Table 9 and 10 here

We now turn to the inspection of accumulation paths by groups which differ in terms of their risk aversion and exposure to risk. Graphs 2a and 2c of Figure 2 show the capital stock-age relationship for two groups that are distinguished using the stable-profits dummy. Graphs 2b and 2d compare MSEs in the first with those from the fourth "risk quartile" based on the risk proxy (principal components) described above. While the upper graphs (2a and 2b) are based on the residuals of a first-stage regression that controls for sector and country effects, the residual used for the lower graphs (2c and 2d) comes from a regression on a constant only. The rationale for reporting these results is that the country and sector effects might capture quite an important part of the variation in risk.

Graph 2a shows that "risk-averse" entrepreneurs (who report to pursue their activity because of "stable profits") indeed invest less capital initially, as we would expect from the theoretical considerations above. The difference is large with capital stocks about 2 times higher for less risk-averse entrepreneurs. With increasing MSE age, these MSEs of risk-averse entrepreneurs seem to adjust their capital stocks upwards, so that MSEs older than five years no longer exhibit significantly lower capital stocks. This behavior is consistent with learning by doing and/or an option value of postponing investment (by more risk-averse entrepreneurs). The analysis by risk proxy quartiles (graphs 2b and 2d) yields a similar

[27] Table 10 provides an overview and description of the key variables used in the empirical analysis.

picture. Less risky activities – possibly those where profits are assumed to be stable – have somewhat lower initial capital stocks that increase with MSE age. Capital stocks in high-risk activities, and thus possibly undertaken by less risk-averse entrepreneurs, are significantly higher in the first two years and decline as MSEs grow older. These higher initial capital stocks would contradict our theoretical model if the two groups were equally risk-averse. Then, the capital stock should be lower in high-risk activities. Yet, we might just see the result of less risk-averse – and wealthier – entrepreneurs selecting themselves into high-risk activities. As we have indicated above, we cannot indentify this selection effect with the data at hand. This logic can also be applied to the findings on aversion. If our "chosen-because-of-stable-profits" dummy reflects low risk rather than risk aversion, the left panel would also speak against the simple theoretical result of lower capital stocks associated with higher risks.

Insert Figure 2 here

While the accumulation paths for MSEs facing different degrees of capital constraints were unaffected by the inclusion of country and sector dummies, this does not hold for the results with regard to risk. Differences in capital accumulation behavior between credit constrained and unconstrained MSEs thus do not seem to be driven by differences between sectors or countries. This, however, appears to be the case for differences between MSEs distinguished by risk groups. Graph 2c (without country and sector controls) looks very similar to graph 2a (with country and sector controls). In contrast, the regression line for high (low) risk activities in graph 2d shifts upwards (downwards) if we exclude country and sector controls while the slope of the lines remains similar (compared to 2b). This systematic difference between 2b and 2d indicates that there are differences in capital accumulation between the two groups that are correlated with the criterion used to form these groups, i.e. business risk. Hence, sectors and countries may indeed differ in terms of risk and not so much in other characteristics that would influence the relationship between capital stock and MSE age. In other words, the country and sector dummies to some extent seem to reflect differences in sector-specific risks and business risks that can be linked to country-level factors, such as access to reliable public infrastructure or the security of contracts. If this was true – and we should acknowledge that there may be many other sector or country-level factors related to both risk and accumulation – graph 2d would reveal the true differences in capital stocks due to differences in risks. Initial capital stocks in risky activities would be about three times higher than in less risky activities.

It is clear from the discussion of risk, wealth and capital accumulation that the apparent puzzle of higher capital stocks in activities with higher risks can be partly explained by wealth differences. This is why we now distinguish entrepreneurs by wealth (the upper panel) and access to capital using the capital constraint dummy from above (the lower panel). Using only half of the sample (the first and the fourth risk quartile for illustrative reasons and since the paths for the second and third risk quartile tend to be in-between, i.e. there are no signs of sharp discontinuities in these relationships) and splitting this sub-sample using the wealth or capital constraint dummy implies that confidence intervals become fairly large, as can be seen in Figure 3. Figure 3 is again only using the residuals from a regression without

controlling for country and sector effects, as including these effects into the first stage regression would imply to exclude key components of the variation in capital stocks across country-sectors due to risk, as explained in the preceding paragraph.

Insert Figure 3 here

The main insight from Figure 3 is that the MSEs with high capital stocks are indeed young, unconstrained MSEs in risky activities. Moreover, while unconstrained entrepreneurs in less risky activities show virtually no changes in capital stocks as they age, there is evidence here for a downward adjustment on the part of their risk-facing counterparts (graphs 3b and 3d). For credit constrained MSEs in risky activities no such decrease can be observed, as they accumulate capital similar to their constrained peers in less risky activities (graphs 3a and 3c).

5.3 Discussion and parametric estimates

Our semi-parametric analysis of the relationship between capital stocks and enterprise age certainly allows for the conclusion that both credit constraints and risks are an obstacle for entrepreneurs in small-scale activities. First, as predicted by the above model, we find that initial capital stocks of entrepreneurs from wealthy households are larger than those of entrepreneurs from asset-poor households. The effect is sizeable; initial capital stocks of wealthy entrepreneurs can be about three times larger. Only after long time periods of about 10 years, MSEs from asset-poor households are able to achieve similar levels of capital. About 75 percent of MSEs, however, are younger than 10 years. Second, and here our findings seem to contradict theory at first sight, we find that capital stocks in risky activities are higher than those in less risky activities. However, this only seems to hold for wealthy, non credit-constrained – and less risk-averse – individuals with young MSEs. Since by self-selection this group dominates risky activities, it explains why capital stocks are higher and not lower for this group. Yet, the finding that capital stocks for this group are lower in older MSEs may indicate that they deviate from optimal levels initially.

These observations have to be interpreted with care as they rely on cross-sectional data only. This requires some reflection on possible biases and spurious correlations that we might have recovered. We certainly expect our estimates to suffer from omitted variable bias: More able entrepreneurs should be less likely to be capital-constrained to begin with. At the same time, ability might be positively correlated with wealth as more able individuals are likely to be in a better position to accumulate wealth through other means than entrepreneurial activity, which in turn influences the willingness to take risks. In addition, more able entrepreneurs may be capable of managing larger enterprises and hence find it easier to accumulate capital.[28] Similarly, enterprise survival will be influenced by ability. In principle, as indicated above, one would assume that more able entrepreneurs are more likely to survive. In terms of differences in accumulation paths between MSEs that are credit-

[28] Evans and Jovanovic (1989) find a negative correlation between entrepreneurial ability and capital stock. Xu (1998), however, shows that this may result from a downward bias in wealth data. Using improved data, he finds a positive correlation, which is theoretically more plausible.

constrained and those that are not, these biases should lead us to observe (even) higher average capital stocks with higher MSE age for firms that are not constrained. Yet, we can only observe a positive relationship between capital stocks and MSE age for capital-constrained MSEs.

With regard to risk, ability biases seem unlikely to explain the observed pattern. If such a bias was relevant, it should explain why wealthy or non-credit-constrained MSEs, have high capital stocks at young age and much lower ones at higher age. More able entrepreneurs may be better in understanding and coping with risk and hence are more likely to achieve optimal capital stocks and accumulation paths. Therefore, they may also be more likely to survive. Among the wealthy entrepreneurs, high-ability entrepreneurs would avoid taking excessive risk and building up capital stocks that are too high for a given level of risk. As the less able entrepreneurs with capital stocks that are too high are bound to fail, this may explain lower capital stocks at higher MSE age because more able entrepreneurs were having lower (optimal) capital stocks from the outset. Although we cannot test whether such processes are behind the observed pattern, their presence would not alter our main conclusions. Even if such biases were driving the results for non credit-constrained entrepreneurs, it is difficult to understand why for constrained entrepreneurs the observed pattern is so different. Finally, disentangling the effects of risk and risk aversion would be desirable. Yet, even with this caveat, our analysis points to an important role for risk, as we can still observe the "combined effect" of selection and risk on average capital stocks at different MSE ages.

As a robustness check, we now parametrically estimate the determinants of capitals stocks. Specifically, we expect MSE age to have a positive effect only for capital constrained enterprises. To test this hypothesis, we estimate the following basic regression equation via OLS:[29]

$$\ln(capital_i) = \alpha + \beta_1 MseAge_i + \beta_2 CreditConstr_i + \beta_3 CreditConstr_i \cdot MseAge_i + \beta_4 Risk_i + \beta_5 Risk_i \cdot MseAge_i + \beta_6 RiskAverse_i + \beta_7 RiskAverse_i \cdot MseAge_i + X_i'\delta + \mu_c + \nu_s + u_i \quad (10)$$

where $capital_i$ is the capital stock of MSE *i*. $CreditConstr_i$, $Risk_i$, $RiskAverse_i$ are proxies for credit constraints, risk, and risk aversion, respectively. These proxies are interacted with $MseAge_i$, the age of the enterprise, which also enters linearly. We control for owner's years of education, sex as well as age and age squared (in X_i) and for country and sector effects (μ_c and ν_s).

Table 11 reports the results of different specifications estimated on different samples to address the possible biases from the drastic reduction in sample size for our non-parametric estimates above. As we use wealth (or the related credit constraint dummy from above) as a proxy for credit constraints, our estimates are likely to suffer from endogeneity bias because of unobserved heterogeneity and/or simultaneity. The fact that we only have cross-sectional

[29] In all regressions, we drop influential outliers from our sample (and sub-samples) that we identify by the DFITS-statistic. As suggested by Belsley et al. (1980), we use a cutoff-value $|DFITS|_{ihj} > 2\sqrt{k/N}$ with *k,* the degrees of freedom (plus 1), and *N*, the number of observations.

data puts very strict limits on the possibilities to address these issues. In addition, an instrumental variable approach towards estimating equation (10) would require the estimation of a system with (at least) two endogenous regressors because of the interaction term(s) of wealth and enterprise age, which we deem infeasible due to the lack of instruments for the interaction terms. Yet, to provide a robustness check for the effects of credit constraints proxied by wealth, we estimate a simpler version of equation (10) without the wealth-MSE age interaction and instrument the wealth index by different variables that are used to construct the wealth index. These instruments are by construction highly correlated with the wealth index. An *F*-test applying critical values suggested by Stock et al. (2002)and Stock and Yogo (2005) confirms their relevance.[30] The idea of this procedure is now to compare the results of IV-estimates using different sets of instruments that we consider likely to differ with regard to the extent to which they suffer from simultaneity. These results are reported in Table 12. We comment on them below.

Insert Table 11 here

The first specification (column (1) of Table 11) incorporates only the credit constraint proxy from above (based on wealth and access to finance) and is based on the sample used in the non-parametric analysis. While there is a large and significant effect of the credit constraint proxy on the capital stock (the capital stock is about 55 percent lower in constrained firms), the interaction between credit constraints and enterprise age is not significant and implies only a small accumulation rate of 2.3 percent annually by constrained firms – it would hence take those firms 10 years to close half the gap to non-constrained firms. As in the other specifications, all the additional controls have the expected sign and are highly significant.

In the remaining specifications, we use wealth as a proxy for credit constraints bearing in mind that it also influences risk-taking behavior. Specification (2) reports the results of a regression that includes wealth quartile dummy variables, the risk (and risk aversion) proxies, and the corresponding enterprise age interactions. Risk is proxied using the principal components risk index and the same risk aversion proxy as above. Estimates in column (2) are based on the reduced sample. The results illustrate that capital stocks increase with wealth; with capital stocks being two times larger for high wealth individuals compared to low wealth individuals in the lowest quartile. Enterprise age does not turn out significant in any specification and the interaction with enterprise age is significant only for the third wealth quartile in the reduced sample. Much more in line with the above non-parametric results are the effects of risk. Risk aversion reduces the capital stock initially by about 35 percent, but with increasing age firms appear to adjust their capital stocks upwards. These effects are found with both the reduced and the full sample, with smaller magnitudes in the latter case. For the reduced sample, we find a strong effect of risk. The standardized beta coefficient of risk (not reported) indicates that a standard deviation change in risk leads to an increase in capital stock by about 15 percent. This risk-induced gap is then reduced by

[30] Further testing (reported in Table 12) gives us confidence in the validity of the IV-estimates. We use the ivreg2 command of STATA to perform these tests (see Baum et al., 2007). The C test (similar to the Hausman test) suggests that wealth indeed cannot be treated as exogenous. Hansen's J test does not reject the null that all overidentifying restriction are true.

about 2 percent of total capital stock with every year the enterprise is in operation. Columns (3) and (4) report the results from a regression which is based on a sample split according to the credit constraint proxy. This allows examining whether we can confirm the different responses to risk of unconstrained vis-à-vis constrained firms. Here, we only include the risk proxies. The effects of the aversion proxy are similar for the two groups – albeit the age interaction is no longer significant. For risk, the effects are significantly larger for unconstrained than for constrained firms. Unconstrained firms in risky activities start with much higher capital stocks (beta coefficient of 0.35), but have lower capital stocks when they grow older (almost 5 percent reduction annually). While still observable for constrained firms, these effects are much smaller for this group.

Instead of the reduced sample used for the non-parametric estimations, column (5) reports results from a regression that additionally includes firms older than 12 years and firms from households with more than one firm. Most effects are similar, but the effect of risk becomes insignificant. Moreover, the interaction of risk and enterprise age is still significant but much smaller. This finding, however, is difficult to interpret, as within-household decisions on the split of capital stock between enterprises are difficult to explain and may depend on a number of factors not accounted for in this paper (and beyond its scope). This holds less for the results reported in column (6) where the same model as before is estimated on a sample of entrepreneurial activities aggregated within the household.[31] While this operation enlarges our sample compared to specifications (1) to (4), it also entails a – possibly important – loss of information, as we have to aggregate the enterprise-specific indices for risk and risk aversion (by simply computing the means within the household). This may also explain why the effects of risk and risk aversion are smaller for this aggregated sample. While the effects of the wealth proxies are similar to those found using the reduced sample (column (2)), the interaction between the first wealth quartile and enterprise is significant here. This may be taken as a sign that – in some households – accumulation takes place through establishing new activities instead of accumulating within existing ones.

Insert Table 12 here

Finally, the results of our IV-estimates suggest that the coefficients of the credit constraint proxies are indeed biased by simultaneity or unobserved heterogeneity. In the first column of Table 12 (specification (7)) we report the results of an OLS estimation of an equation that includes the wealth index – instead of wealth quartile dummies – and no interaction of wealth with MSE age. In specification (8) we instrument the wealth index by dummy variables for the possession of a TV, a Hifi, and a radio, respectively. Specification (9) uses dummy variables for the quality of housing and for the presence of tap water as instruments instead. While the strong and highly significant effect of wealth becomes stronger using the first set of instruments, it is weaker, but still large using the second set. In fact, these changes are in line with expectations as entrepreneurs who own entertainment equipment are likely to dispose of more liquid means. Living in a high-quality house and having access to tap water may better describe the concept of exogenous wealth that can, for example, be

[31] We include a dummy for multiple enterprises in this regression.

used as collateral, but is not determined simultaneously with the current level of capita stock. Hence, while our wealth proxy appears to be partly endogenous, these results indicate that capital stocks of wealthy entrepreneurs are indeed significantly and considerably larger. Furthermore, the effects of risk, risk aversion and the respective interactions with enterprise age are unaffected by instrumenting wealth. If these variables were heavily affected by the endogenous regressor wealth, these effects would be biased as well. The stability of the coefficients gives some confidence that this is not the case.

In sum, our parametric estimates cast some doubts on the previous result that capital accumulation in constrained firms is mainly driven by the investment of retained earnings. However, this may be partly due to an over-parametrization of an empirical model where we expect explanatory and interacted variables, more specifically wealth, risk (aversion) and enterprise age, to be correlated. Yet, the differences in capital stocks between MSEs operated by wealthy and poor individual (in terms of non-business assets) are very large and may be taken as a sign of credit constraints – even if the obvious endogeneity problem is accounted for. The robust results on risk and the corresponding interaction terms are more assuring. We consistently find riskier activities to exhibit higher capital stocks with this effect dying out with increasing firm age. Similarly, risk aversion leads to lower capital stocks initially that are adjusted upwards with age. These effects are smaller for low-wealth individuals.

6. Conclusions

This study has examined the effects of both capital market imperfections and risk on capital stocks of informal MSEs in Western Africa. Both capital constraints and risk may explain why capital accumulation in the informal sector is low and the potential of many entrepreneurs underexploited. Our analysis of the determinants of capital stocks of MSEs therefore provides indirect evidence of the causes of the high returns to capital in small-scale activities that a number of recent studies have identified.

We find that capital constraints are indeed important. Credit-constrained MSEs start with much lower capital stocks than their unconstrained counterparts, but entrepreneurs seem to be able to reach their optimal capital stocks as MSEs grow older. However, this process takes too much time and the age profiles suggest that only few MSEs reach the necessary age of about eight to ten years. This result is in line with much of the literature on capital accumulation at the firm level. Less previous evidence, however, has been provided with regard to the role of risk. Our analyzes suggest that risks may be even more important than capital constraints. Risk-averse individuals seem to adjust their initially low capital stocks upwards when enterprises grow older. Such behavior may be an optimal response to prevailing risks given the individual's risk aversion. Yet, risk aversion may be high because individuals face a number of risks that they cannot insure and that do not need to be related to the business. In addition, even in those capital-scarce countries, we can identify MSEs that seem to over-invest in the initial phase of their business and adjust their capital stocks

downwards. As other firms simultaneously suffer from capital shortages, such behavior may imply large inefficiencies.

The mirror image of the importance of both capital constraints and risk is the important role of household wealth that we identified. For two reasons household wealth seems to be of crucial importance in our context. First, it allows households to finance investment either directly or indirectly by using it as collateral. Second, wealthy households may not need to engage in precautionary savings which seems to act as a major deterrent to investment for poorer households. Indeed, in our context entrepreneurs are not only exposed to business risks but also – or in particular – to substantial risks unrelated to business activities such as catastrophic health expenditures or unexpected 'ceremonial' expenditures, which are typically not formally insured. Unfortunately, our dataset does not allow us to fully disentangle those two effects of wealth. However, some results of our empirical analysis, in particular the ambiguous relationship between risk (aversion) and wealth as well as the instrumental variable-estimates, casts some doubts on the importance of wealth for risk behavior.

More generally, the results can also be taken as another piece of evidence that an important part of MSEs remains small and grow only little, since their owners are constrained by market imperfections and operate in high-risk environments. These business owners should hence be considered constrained entrepreneurs rather than urban subsistence dwellers forced into these activities because of a lack of other options. This view is not only in line with the evidence on high returns to capital in small-scale activities, but also with the few empirical studies that have studied MSE dynamics in poor countries (e.g. Fajnzylber *et al.*, 2006). We hence think that our study is an important step in addressing this lack of empirical studies for the poorest countries despite the fact that we have to rely on cross-sectional data and retrospective "hypothetical" dynamics. Detailed panel data on MSEs are still rare, in particular for African countries. Furthermore, we believe that the various robustness checks we undertake and the level of detail we can provide lends quite some support to our main findings.

One may now argue that the empirical focus on capital in this study and in much of the recent literature on MSEs is misguided, as labor, not capital, is the main input into most MSE activities. For our sample for example, production function estimates indicate a labor share of roughly two thirds of value added. We therefore share the view that labor should certainly not be left out of the debate about why so many MSEs do not grow. In fact, hiring additional labour may posit another key constraint to MSEs, for example as monitoring costs may be very high.[32] While such questions merit further investigation, answering them goes beyond the scope of this paper. We think that our focus on capital accumulation is justified for two reasons. First, capital accumulation can contribute very significantly to income growth, and it can do so fairly fast at relatively low levels of capital. This is also why, second,

[32] In this context, it is interesting to note that we cannot find any evidence of complementarities between capital and human capital. Hence, our findings with regard to capital accumulation hold independently of the level of skills of the entrepreneur (measured by the best available but imperfect proxies, i.e. schooling and apprenticeships).

it is so important to understand the causes for little accumulation, which economic policies may be able to address.

From a policy perspective, our findings may accordingly be taken as an argument for providing households with credit, savings devices, and insurance. Many households would be better off if they were able to invest in the enterprises of those who are credit-constrained. In other words, well-functioning capital markets would enable households to make Pareto-improving capital transfers. Savings devices would also enable households to insure against business and non-business risks while channelling savings into productive investment instead of withholding liquidity for insurance purposes. More sophisticated and specific (micro-) insurance products may also set free additional resources that can be put into productive use in MSEs. Our analyses certainly suggest that informal sector policies need to address both, access to capital (and capital costs) and risks, whether business-related or not. Finally, a reliable and stable business environment would be conducive to capital accumulation in MSEs.

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Tables

Table 1: Basic descriptive statistics of informal MSEs

	Mean	Median
MSE age	7.5	5.0
Owner's age	36.3	35.0
Owner's years of schooling	3.7	3.0
Owner's experience	6.9	4.0
Owner female	0.51	
Firm size	1.7	
Share of pure self-employment	0.69	
Monthly profit (in 2001 international Dollar)	385.3	112.9
Capital stock (in 2001 international Dollar)	1,015.6	76.9
Number of observations	6,499	

Source: Authors' computation based on 1-2-3 surveys (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: Monetary values are in current 2001 international dollars on the basis of the Purchasing Power Parity converters for GDP from the World Development Indicators (World Bank, 2010).

Table 2: Basic descriptive statistics of informal MSEs, by quartiles of capital stock (Values in 2001 international Dollar)

	Quartiles of capital stock			
	1	2	3	4
MSE age	6.6	7.7	8.1	7.4
Owner's age	35.1	36.5	36.4	37.3
Owner's years of schooling	3.1	2.7	3.8	5.2
Owner's experience	6.1	7.2	7.4	6.9
Owner female	0.7	0.6	0.4	0.3
Firm size	1.2	1.3	1.8	2.4
Share of pure self-employment	0.9	0.8	0.6	0.4
Monthly profit	196.0	231.0	387.2	728.1
Capital stock	4.3	39.7	210.4	3,810.9

Source: Authors' computation based on 1-2-3 surveys (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: 6,499 observations.

Table 3: Age profile of MSEs

	Capital Quartile				
MSE age	1	2	3	4	Total
1	18.77	15.03	12.42	14.84	15.28
2	15.3	13.4	11.9	12.8	13.4
3	11.6	11.24	10.99	11.02	11.22
4 or 5	16.2	15.3	16.4	16.6	16.1
6 or 7	8.38	9.01	10.62	11.39	9.85
8 to 10	10.6	10.4	11.7	10.2	10.7
11 to 15	8.63	11.8	11.43	10.16	10.49
15 to 20	4.6	5.8	6.2	6.0	5.7
older than 20	6.01	8.01	8.34	6.96	7.32
	100	100	100	100	100

Source: Authors' computation based on 1-2-3 survey (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: 6,499 observations.

Table 4: Proxies for credit market constraints

Wealth quartile	Access to family finance	Access to external finance	Liquidity a problem	Credit a problem	Credit expensive	Bank credit	Micro-credit
1	0.03	0.12	0.14	0.52	0.28	0.00	0.01
2	0.04	0.09	0.10	0.45	0.28	0.00	0.03
3	0.04	0.09	0.13	0.49	0.31	0.01	0.04
4	0.05	0.09	0.12	0.42	0.30	0.01	0.04
All	0.04	0.10	0.12	0.47	0.29	0.01	0.03

Source: Authors' computation based on 1-2-3 survey (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: 3,109 observations.

Table 5: Proxies for credit market constraints, correlation matrix

	Access to family finance	Access to external finance	Liquidity a problem	Credit a problem	Credit expensive	Bank credit	Micro-credit
Access to external finance	-0.01	1.00					
	0.52						
Liquidity a problem	0.03*	0.02	1.00				
	0.08	0.35					
Credit a problem	0.01	-0.03*	0.11	1.00			
	0.44	0.10	0.00				
Credit expensive	0.02	-0.04**	0.08***	0.55***	1.00		
	0.35	0.04	0.00	0.00			
Bank credit	0.01	0.03*	-0.01	-0.01	0.00	1.00	
	0.67	0.06	0.42	0.63	0.99		
Micro-credit	-0.03	0.06***	0.03**	0.02	0.02	0.06***	1.00
	0.16	0.00	0.03	0.31	0.34	0.00	
Wealth index	0.03*	-0.04***	-0.03*	-0.06*	0.01	0.04*	0.05**
	0.10	0.03	0.10	0.00	0.61	0.02	0.01

Source: Authors' computation based on 1-2-3 surveys (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: 3,109 observations. The second row for each indicator reports significance levels. ***, **, and * denote significance at the one-, five-, and ten-percent level, respectively.

Table 6: Risk proxies, summary statistics

	Mean	Min	Max	N
Profit variation	2.02	0.78	4.50	3,109
Sales variation	2.03	0.75	6.01	3,109
Competition/no clients as major risks	0.62	0	1	3,109
Some risk of closure	0.90	0	1	3,109
Chosen because of stable profits	0.10	0	1	3,109

Source: Authors' computation based on 1-2-3 surveys (Phase 2, 2001/02, AFRISTAT, DIAL, INS).

Table 7: Risk proxies, correlation matrix

	Profit variation (cs)	Sales variation (cs)	Competition/no clients as major threat	Some risk of closure
Sales variation (cs)	0.49***	1.00		
	0.00			
Competition/no clients as major threat	0.01	0.03	1.00	
	0.77	0.13		
Some risk of closure	0.03**	0.04**	0.42***	1.00
	0.03	0.02	0.00	
Chosen because of stable profits	0.01	-0.04**	-0.03	-0.06***
	0.54	0.03	0.12	0.00

Source: Authors' computation based on 1-2-3 surveys (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: 3,019 observations. "cs" refers to country-sector, i.e. we measure the variation within country-sector cells. The second row for each indicator reports p-values. ***, **, and * denote significance at the one-, five-, and ten-percent level, respectively.

Table 8: Risk index, results from principal components analysis

	Eigen-value	Propor-tion	Cumu-lative	Variable loadings	Compo-nent 1	Compo-nent 2
Component 1	1.77	0.29	0.29	Sales variation (cs)	0.14	-0.19
Component 2	1.26	0.21	0.50	Some risk of closure	0.45	0.48
Component 3	0.99	0.17	0.67	Some risk of closure (cs)	0.54	-0.39
Component 4	0.93	0.16	0.82	Competition/no clients as major threat	0.42	0.58
Component 5	0.61	0.10	0.93	Competition/no clients as major threat (cs)	0.43	-0.09
Compenent 6	0.44	0.07	1.00	Chosen because of stable profits (cs)	-0.36	0.49

Source: Authors' computation based on 1-2-3 surveys (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: 6,499 observations. cs refers to country-sector, i.e. we measure the variation within country-sector cells. The first three columns list the ordered eigenvalues of the correlation matrix and the variance explained by the single components. The two columns on the right show the associated eigenvectors.

Table 9: Risk index and risk aversion proxy by capital and wealth quartiles

Capital quartile	1	2	3	4	All
Wealth quartile					
Risk Index					
1	-0.21	0.10	0.29	-0.03	0.02
2	-0.23	-0.03	0.52	0.12	0.09
3	-0.23	-0.12	0.12	0.19	0.01
4	-0.27	-0.17	0.30	0.21	0.07
All	-0.23	-0.04	0.31	0.15	0.05
Activity chosen for stable profits					
1	0.15	0.11	0.05	0.11	0.11
2	0.16	0.07	0.07	0.08	0.10
3	0.11	0.10	0.07	0.05	0.08
4	0.10	0.10	0.09	0.08	0.09
All	0.14	0.10	0.07	0.08	0.10

Source: Authors' computation based on 1-2-3 surveys (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: 3,019 observations.

Table 10: Overview of variables used in the empirical analyses

	Comment
Capital	Replacement value of all business-related assets owned by the entrepreneur and used for the operation of the enterprise in the last year, including the business establishment, machines, furniture, vehicles and utilities
MSE/enterprise age	Constructed from a question that asks the owner for the year when the enterprise was established
Wealth index	First principal component of a principal components analysis, included variables: Housing characteristics (floor, number of rooms, electric light, tap water, sanitation facilities), TV, Hifi, Video, gas cooker
Proxy variables for access to capital	
Access to family finance	Dummy set to 1 if any capital stock item has been financed through funds provided by the family
Access to external finance	Dummy set to 1 if any capital stock item has been financed externally (i.e. loans from clients, loans from suppliers, loans from business associations, loans from informal money lenders, loans from micro-finance institutions and loans from formal banks).
Liquidity a problem	Dummy variable "Lack of liquidity" the main difficulty threatening the existence of the MSE (no multiple answers, out of 12)
Credit a problem	Dummy variable "Do you have problems or difficulties in the following areas?", answer: "Finance (difficulties to access credit)" (multiple answers, out of 13)
Credit expensive	Dummy variable "Do you have problems or difficulties in the following areas?", answer: "Finance (credit too expensive)" (multiple answers, out of 13)
Bank credit	"Have you ever obtained a credit from a bank?"
Micro-credit	"Have you ever obtained a credit from a microcredit institution?"
Risk-related variables	
Competition/no clients as major risks	Dummy variable, "Which is the major threat to the existence of the MSE?", answer "the lack of clients" or "too much competition" (no multiple answers)
Some risk of closure	Dummy variable, "Which is the major threat to the existence of the MSE?", set to 1 if any threat is being mentioned
Aversion proxy = "Chosen because of stable profits" dummy	Dummy variable, motivation for taking up the specific business activity, answer "Assurance of more stable receipts than in other products" (no multiple answers, other options: "family tradition", "expertise in this business", "higher profits than other businesses", "others")
Risk index	First principal component of a principal components analysis, included variables: see Table 8.
Other control variables	
Owner's education	Years of schooling (not counting for repeated years)
Multiple enterprise dummy	Dummy set to one if there is more than one MSE in the household

Table 11: Regression results

	Dependent variable: Ln(capital)					
	(1)	(2)	(3)	(4)	(5)	(6)
Credit constraint proxy	-0.810***					
	(0.094)					
Credit constraint proxy x enterprise age	0.023					
	(0.016)					
2nd wealth quartile		0.314***			0.197**	0.247***
		(0.120)			(0.080)	(0.083)
3rd wealth quartile		0.537***			0.734***	0.745***
		(0.125)			(0.081)	(0.089)
4th wealth quartile		1.076***			1.060***	1.105***
		(0.133)			(0.086)	(0.096)
2nd wealth quartile x enterprise age		-0.023			-0.003	-0.009
		(0.021)			(0.008)	(0.007)
3rd wealth quartile x enterprise age		0.030			-0.013*	-0.011
		(0.023)			(0.008)	(0.007)
4th wealth quartile x enterprise age		-0.015			-0.002	-0.001
		(0.023)			(0.008)	(0.008)
Aversion proxy		-0.358**	-0.540**	-0.355**	-0.217**	-0.268**
		(0.148)	(0.273)	(0.143)	(0.101)	(0.109)
Aversion proxy x enterprise age		0.046	0.049	0.045	0.022*	0.027**
		(0.030)	(0.051)	(0.028)	(0.013)	(0.012)
Risk index		0.154***	0.357***	0.099**	0.041*	0.072**
		(0.038)	(0.074)	(0.043)	(0.024)	(0.028)
Risk index x enterprise age		-0.020***	-0.047***	-0.013*	-0.003	-0.004**
		(0.007)	(0.012)	(0.007)	(0.002)	(0.002)
Enterprise age	-0.014	0.001	0.013	-0.005	0.008	0.010*
	(0.014)	(0.016)	(0.017)	(0.010)	(0.006)	(0.005)
Owner's education	0.082***	0.071***	0.074***	0.082***	0.071***	0.060***
	(0.007)	(0.007)	(0.011)	(0.009)	(0.006)	(0.007)
Owner female	-1.087***	-1.119***	-0.887***	-1.232***	-1.160***	-1.129***
	(0.065)	(0.062)	(0.124)	(0.075)	(0.048)	(0.059)
Age	0.104***	0.087***	0.090***	0.097***	0.091***	0.091***
	(0.012)	(0.014)	(0.028)	(0.014)	(0.009)	(0.009)
Age^2	-0.001***	-0.001***	-0.001**	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Multiple enterprise dummy						0.089
						(0.127)
Constant	5.061***	2.522***	3.680***	4.461***	3.422***	1.852***
	(0.273)	(0.299)	(0.533)	(0.294)	(0.206)	(0.222)
R-squared	0.452	0.458	0.432	0.455	0.435	0.426
N	2,940	2,935	989	1,944	5,354	4,516

Source: Authors' computation based on 1-2-3 surveys (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: Robust standard errors in parentheses, clustered around the sample cluster-identifier. All regressions include country and sector dummy variables (not shown). ***, **, and * denote significance at the one-, five-, and ten-percent level, respectively.

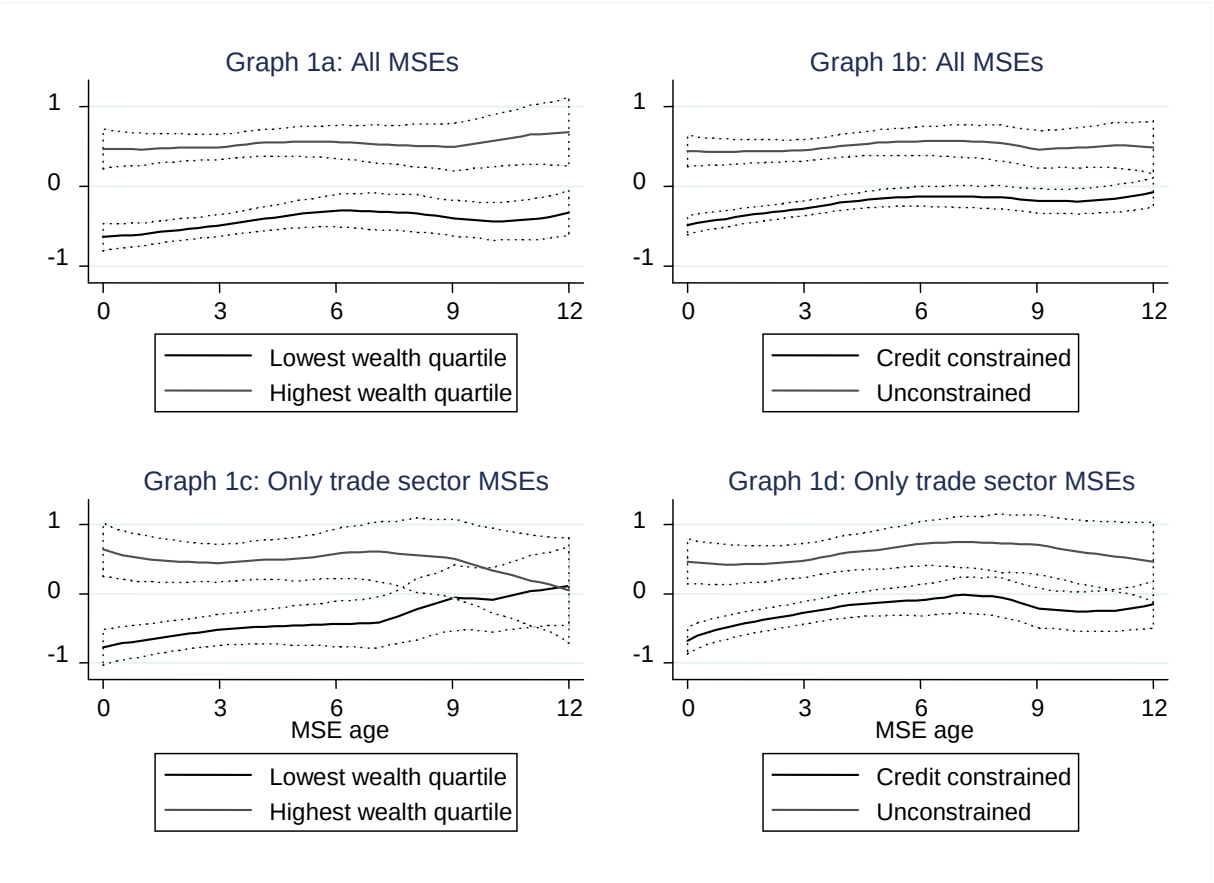
Table 12: Instrumental variable estimates

	Dependent variable: Ln(capital)		
	(7)	(8)	(9)
Wealth index^{+}	0.231***	0.266***	0.173***
	(0.017)	(0.024)	(0.024)
Aversion proxy	-0.333**	-0.333**	-0.333***
	(0.130)	(0.130)	(0.128)
Aversion proxy x enterprise age	0.033	0.035	0.031
	(0.024)	(0.024)	(0.024)
Risk index	0.172***	0.171***	0.174***
	(0.037)	(0.037)	(0.037)
Risk index x enterprise age	-0.021***	-0.021***	-0.021***
	(0.006)	(0.006)	(0.006)
Enterprise age	-0.002	-0.002	-0.001
	(0.009)	(0.009)	(0.009)
Owner's education	0.069***	0.065***	0.077***
	(0.007)	(0.007)	(0.007)
Owner female	-1.139***	-1.151***	-1.118***
	(0.067)	(0.068)	(0.067)
Age	0.090***	0.089***	0.091***
	(0.013)	(0.013)	(0.013)
Age^{2}	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)
Constant	4.812***	3.473***	3.257***
	(0.266)	(0.260)	(0.261)
R-squared	0.459	0.458	0.457
N	2,941	2,941	2,941
C test for endog. of wealth		4.882	9.525
Chi-sq(1) p-value		(0.027)	(0.002)
Weak identification test (Kleibergen-Paap rk Wald F statistic)		1,161.379	1,080.542
p-value		(0.0000)	(0.0000)
Underidentification test (Kleibergen-Paap rk LM statistic)		940.635	674.948
p-value		(0.0000)	(0.0000)
Partial R-2		0.5939	0.4806
Hansen's J statistic		0.256	0.134
p-value		0.8798	0.7143

Source: Authors' computation based on 1-2-3 surveys (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: $^{+}$ instrumented in (8) and (9). Robust standard errors in parentheses, clustered around the sample cluster-identifier. All regressions include country and sector dummy variables (not shown). ***, **, and * denote significance at the one-, five-, and ten-percent level, respectively.

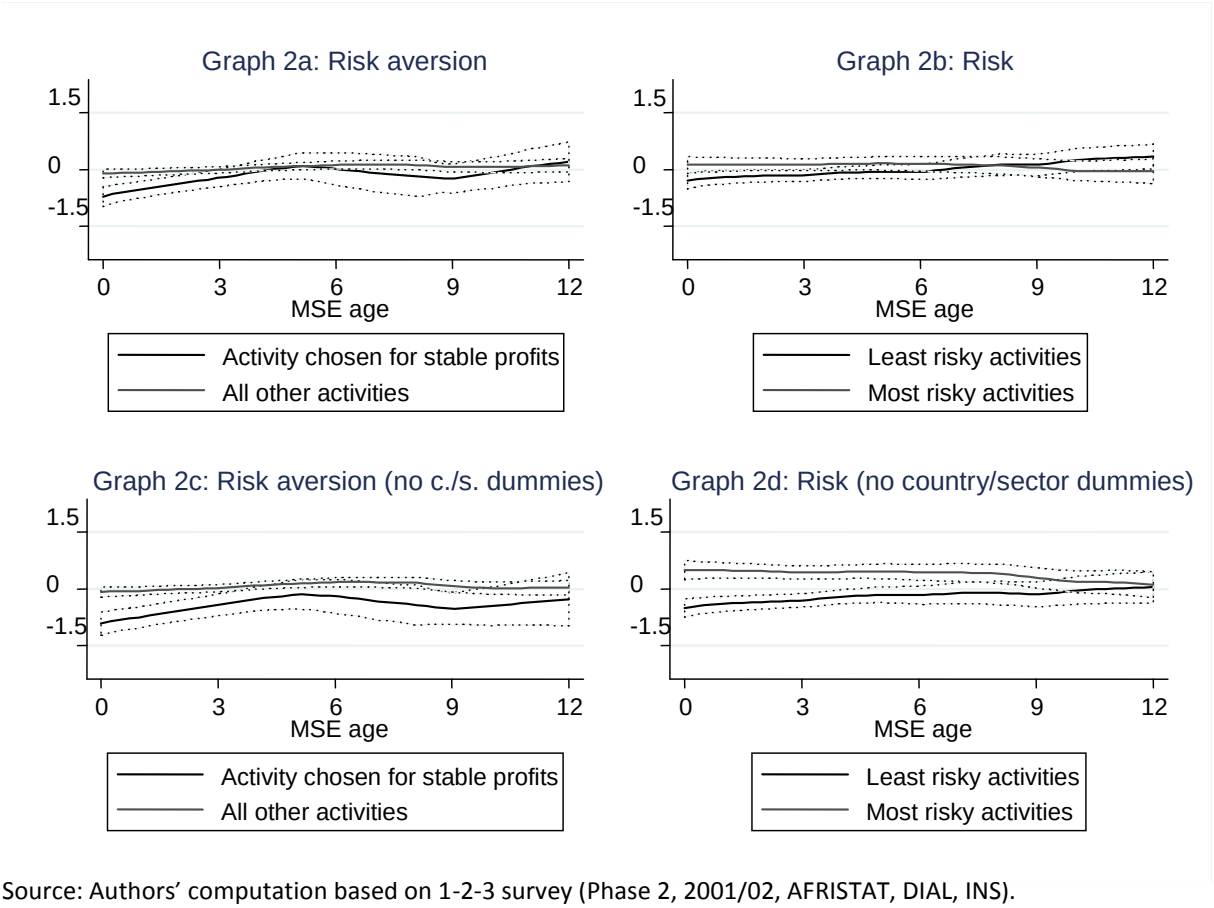
Figures

Figure 1: Capital stock and MSE age, by groups with different wealth levels and different access to capital



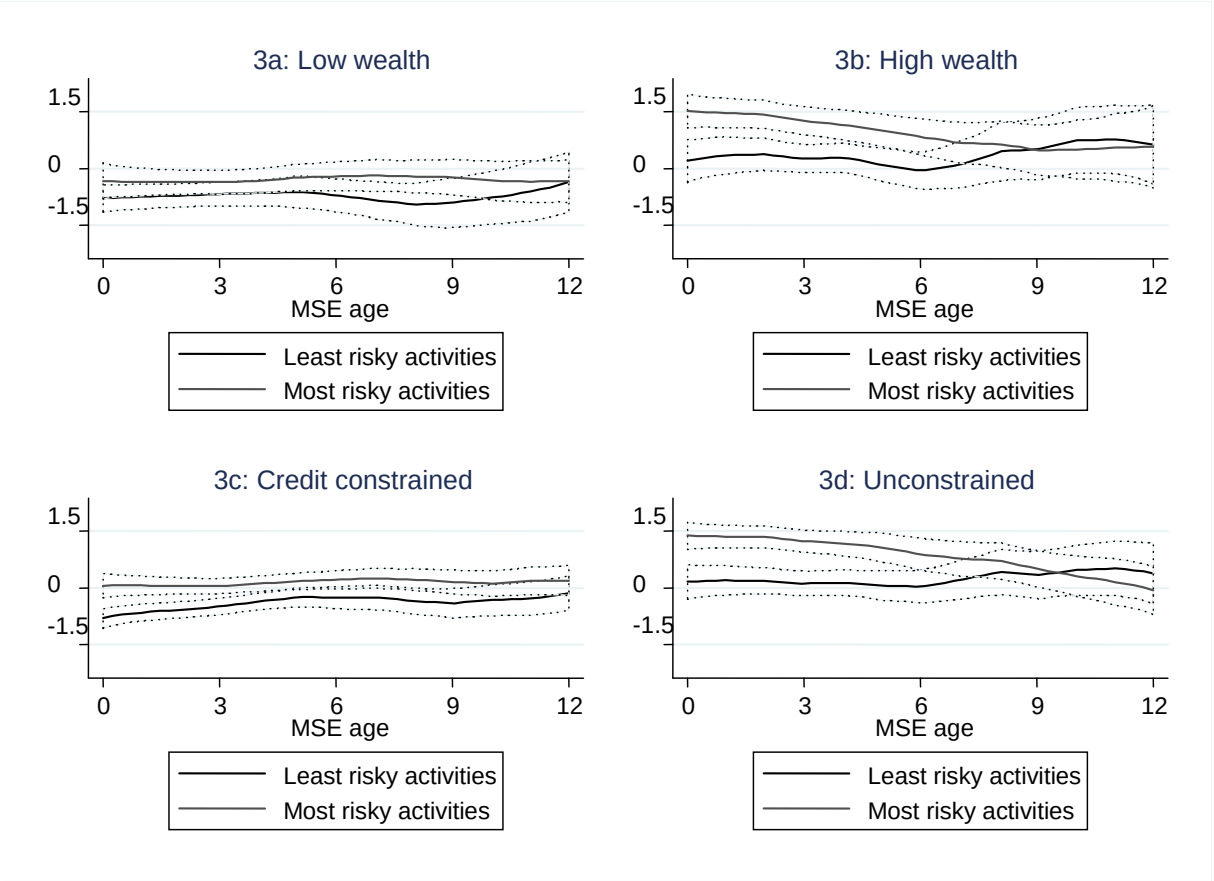
Source: Authors' computation based on 1-2-3 survey (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: Non-parametric regression of capital stocks on MSE age (capital stocks are residuals from regression of log capital on country and sector dummies); upper panels for all sectors, lower panels only for the trade sector. In the left panels MSEs are distinguished by wealth levels (low wealth the first quartile and high wealth the fourth quartile) in the left panels by access to capital (defined as described in the text).

Figure 2: Capital stock and MSE age, by groups with different degrees of risk aversion and different risks



Source: Authors' computation based on 1-2-3 survey (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: Non-parametric regression of capital stocks on MSE age (capital stocks are residuals from regression of log capital on country and sector dummies in the upper panels and from a regression on a constant only in the lower panels).

Figure 3: Capital stock and MSE age, by groups with different risks plus different wealth levels and different access to capital



Source: Authors' computation based on 1-2-3 survey (Phase 2, 2001/02, AFRISTAT, DIAL, INS).
Notes: Non-parametric regression of capital stocks on MSE age (capital stocks are residuals from regression of log capital on a constant only). The upper panels further distinguish MSEs by wealth levels (low wealth the first quartile and high wealth the fourth quartile) and access to capital (defined as described in the text).